CONNECTICUT RIVER FLOOD CONTROL PROJECT

WEST SPRINGFIELD, MASS.

CONNECTICUT RIVER, MASSACHUSETTS

ANALYSIS OF DESIGN FOR BRIDGE STREET PUMPING STATION

ITEM W.S. 7b–CONTRACT

JANUARY, 1941

CORPS OF ENGINEERS, U. S. ARMY

U. S. ENGINEER OFFICE PROVIDENCE, R.I.

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I. INTRODUCTION

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A. AUTHORIZATION AND PAST REPORTS. - The Bridge Street Pumping Station is a part of the local protection works for the Town of West Springfield. The West Springfield Dike project is a part of the Connecticut River flood control plan included in the Comprehensive Plan of Flood Control for the Connecticut River as described in House Document No. 455, 75th Congress, 2d Session, and authorized under the Flood Control Act approved June 28, 1938.

B. NECESSITY FOR THE STATION. - As a part of the flood protection works for that section of West Springfield between the Memorial Bridge and the North End Bridge, a pumping station at Bridge Street is necessary to discharge the sanitary and storm sewage into the river and thus prevent the backing up of water in the sewers and flooding of the protected area during periods of high water in the river. The Bridge Street Pumping Station has a drainage area of 534 acres which is shown on Plate No. 1.

C. CONSULTATION WITH THE TOWN OF WEST SPRINGFIELD. - Preliminary to and during the actual design of the station, consultations were held with officials representing the Town of West Springfield. These include the Chairman and other members of the Board of Selectmen, the town engineer, the head of the sewer department, and others. The pumping station design, as finally developed, meets with the approval, in its essentials, of the Town of West Springfield.

D. SHORT DESCRIPTION OF THE STATION. - The building which will house the pumps and other equipment will consist of a reinforced concrete substructure and a superstructure, one story high, of structural steel and brick with glass block panels serving as windows. The concrete roof slab of the building will be covered directly with a 4-ply asphalt and gravel roof. The engine room will contain the gasoline engines and right angle gear units for the three 30-inch propeller type pumps, the electric motor for the 16-inch volute pump, and accessory equipment. An overhead crane will be installed for handling the equipment.

A reinforced concrete conduit adjacent to the south wall of the pumping station substructure will serve as the gravity flow conduit and will be provided with gates to prevent backwater during pumping periods. An intake structure for the pumping station will be constructed near the center of the west wall for housing the racks and their hoists. The existing brick sewer will be replaced by a concrete conduit for a distance of about 18 feet from the junction manhole to the intake structure. A grouted riprap channel will be provided to conduct the discharge of the 30-inch pumps to the Connecticut River.

II. SELECTION OF THE SITE

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The pumping station site is landward of the flood wall at Bridge Street near the existing sewer outlet.

This location was chosen for the following principal reasons:

(a) The Bridge Street trunk sewer which drains the tributary area discharges at the site. It is not economically feasible to divert the sewage to any other point.

(b) The foundation conditions are satisfactory for the construction of the station.

(c) It is adaptable to fit in with the plans for future sewage disposal of the Town of West Springfield which contemplates conducting all sanitary sewage to the vicinity of the location of the Bridge Street pumping station.

III. FOUNDATION INVESTIGATIONS

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Foundation conditions were determined by seven 2-1/2-inch drive sample borings. Location of applicable borings is shown on Plate No. 3. Foundation conditions are shown in the geologic section on Plate No. 3. Numbers in boring logs on this profile are those of the Providence Soil Classification shown graphically on Plate No. 4 and described in Table No. 1. Slightly compressible material, predominantly consisting of interstratified silt and lean clay, occurs in a layer approximately 36 feet thick under the adopted location for the pumping station.

The estimated dead load of the station is 1.25 tons per square foot. The estimated load of soil released by excavation is 1.22 tons per square foot. For this small increase in soil load of 0.03 ton per square foot, building settlements will be very small, estimated to be less than 1/2 inch.

It is expected that excavation will be carried approximately eight feet below ground water level. In order to avoid a quick condition in the silty sand upon which the station will rest, it will be necessary **either** to lower the ground water level in the immediate vicinity by use of well points or other pumping measures or cut off the flow by driving sheeting into the silt layer underlying the gravel stratum.

The riverside impervious blanket will be constructed of a compact glacial till, Classes 9 - 11 and 11 - 13, as used in adjacent portions of the dike now complete.

TABLE NO. 1

PROVIDENCE SOIL CLASSIFICATION
UNITED STATES ENGINEER OFFICE
PROVIDENCE, RHODE ISLAND

CLASS	DESCRIPTION OF MATERIAL
1	Graded from Gravel to Coarse Sand. - Contains little medium sand.
2	Coarse to Medium Sand. - Contains little gravel and fine sand.
3	Graded from Gravel to Medium Sand. - Contains little fine sand.
4	Medium to Fine Sand. - Contains little coarse sand and coarse silt.
5	Graded from Gravel to Fine Sand. - Contains little coarse silt.
6	Fine Sand to Coarse Silt. - Contains little medium sand and medium silt.
7	Graded from Gravel to Coarse Silt. - Contains little medium silt.
8	Coarse to Medium Silt. - Contains little fine sand and fine silt.
9	Graded from Gravel to Medium Silt. - Contains little fine silt.
10	Medium to Fine Silt. - Contains little coarse silt and coarse clay. Possesses behavior characteristics of silt.
10C	Medium Silt to Coarse Clay. - Contains little coarse silt and medium clay. Possesses behavior characteristics of clay.
11	Graded from Gravel or Coarse Sand to Fine Silt. - Contains little coarse clay.
12	Fine Silt to Clay. - Contains little medium silt and fine clay (colloids). Possesses behavior characteristics of silt.
12C	Clay. - Contains little silt. Possesses behavior characteristics of clay.
13	Graded from Coarse Sand to Clay. - Contains little fine clay (colloids). Possesses behavior characteristics of silt.
13C	Clay. - Graded from sand to fine clay (colloids). Possesses behavior characteristics of clay.

IV. HYDROLOGY

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A. DRAINAGE AREA.

1. Present conditions. - A total area of 534 acres of West Springfield, bounded by Park Avenue, Norman Street, Memorial Avenue, and the flood wall along the Connecticut River, shown as Areas I and II on Plate No. 1, drains to the Bridge Street station. The entire area is relatively flat with an average elevation of approximately 60 feet above mean sea level. At the present time the area is developed as follows:

Fully developed commercial	- 105 acres
Partially developed industrial	- 98 acres
Fully developed residential	- 175 acres
Partially developed residential	- 156 acres
Total	- 534 acres

2. Probable future conditions. - It is probable that the existing sewer system in this area will be modified at some time in the future in such a manner that there will be a reduction in area tributary to the Bridge Street pumping station (see Paragraph B-2). Under these conditions 437 acres, shown as Area I on Plate No. 1, will be the total drainage area contributing to the Bridge Street pumping station, and may be classified as follows:

Fully developed commercial	- 91 acres
Partially developed industrial	- 98 acres
Fully developed residential	- 175 acres
Partially developed residential	- 73 acres
Total	- 437 acres

B. SEWER FACILITIES.

1. Existing sewers. - The area tributary to the Bridge Street pumping station is served by two storm sewer systems; one system for the area east of the Boston and Albany Railroad tracks and north of Bridge Street, and the other system for the area west of these railroad tracks and south of Bridge Street.

The first area is entirely sewered, partially by combined sewers and partially by separate sewer systems. There are two outfalls in this area: a 40-inch by 60-inch egg-shaped, brick, combined flow sewer in Bridge Street, laid to a grade not exceeding 0.10 percent, with a capacity of 48 cubic feet per second, and a 66-inch circular concrete relief sewer in Day and Cottage Streets, laid to a 0.10 percent grade and interconnected with the old sewer system at Union Street and at Main Street by means of weirs in common manholes. During periods of normal run-off from this area, or when the relief sewer is closed by a gate in times of high water on the Connecticut River, the entire flow is delivered to the Bridge Street sewer. When sewer capacities are overtaxed by storm run-off during normal stages of the Connecticut River, drainage of the area is accomplished through both the Bridge Street sewer and the relief sewer. A small sanitary system, principally in Main Street, outfalls down Cottage Street through a 24-inch pipe. During high stages of the Connecticut River, this sewer can be closed by means of a gate valve. It is to be noted that during times when pumping is required, the total capacity of this system is only 48 cubic feet per second.

The second area is served by storm and sanitary sewers, and, at the present time, the combined flow is carried down Memorial Avenue and

Bridge Street to the Connecticut River by a single sewer. The city is constructing a trunk storm sewer in Memorial Avenue parallel to the existing sewer and in New Bridge Street from Norman Street to the river. When construction is completed, in the near future, the storm sewers will be connected to this trunk sewer, and this area will be served by separate sewer systems. The lower portion of the storm sewer is a 42-inch circular concrete sewer, laid to a 0.20 percent grade, with a capacity of 42 cubic feet per second. There is a pumping station at the foot of Bridge Street at the present time, with a capacity of 22 cubic feet per second against a 20-foot static head, to provide for sanitary sewage and seepage through the dike.

It is not known when the sewer facilities will be extended in these areas beyond the present work under construction. The total present sewer capacity for both areas is only 90 cubic feet per second.

2. Future sewers. - It is probable, in the future, that the storm run-off from 97 areas, the area west of the railroad tracks, shown as Area II on Plate No. 1, will be diverted into the ox-bow pond by the construction of a relief sewer at Circuit Avenue. The existing sanitary sewer would not be diverted to the ox-bow pond, since the discharge of sanitary sewage into the pond would be undesirable.

Since the capacity of the existing sewer in Bridge Street is overtaxed by intensive storm run-off during high stages of the Connecticut River, it is probable that the sewer now being constructed in New Bridge Street would be interconnected to the storm sewer in Union Street to act as a relief for the Bridge Street sewer.

C. SEEPAGE. - Since the seepage through the WS.5 protective works is estimated to be small in relation to the requirements for storm run-off from this area, no extra allowance has been made to provide for it.

D. MINIMUM PUMPING ELEVATION. - The minimum pumping elevation at the Bridge Street pumping station, at which pumping must start in order that the railroad underpasses at Union Street and at Main Street and the basements along Bridge Street will not be subject to flooding, is 50 feet above mean sea level.

E. TIME OF CONCENTRATION. - The time of concentration was determined to be one hour, by assuming an inlet time and by computing the travel time of the storm run-off in the sewer system.

V. DETERMINATION OF DISCHARGE CAPACITY

V. DETERMINATION OF DISCHARGE CAPACITY

A. REQUIREMENTS FOR DISCHARGE CAPACITY. - The pumping station will be of sufficient capacity to meet the following requirements:

1. Discharge the run-off from the total drainage area from a one-hour storm with a probable chance of occurrence of 10 percent in any one month, when pumping against a river stage with a probable chance of occurrence of 10 percent occurring in the same month.

2. Discharge 40 percent of the run-off from the total drainage area from a 1-hour storm with a probable chance of occurrence of 10 percent in any one month, when pumping against a river stage with a probable chance of occurrence of 0.10 percent, occurring in the same month.

3. Discharge the seepage through the local protection works in addition to the storm run-off.

4. Hold the water surface in the sewers at an elevation not to exceed 50 feet above mean sea level when pumping as under subparagraphs 1, 2, and 3.

B. RAINFALL. - Rainfall records for a 35-year period at Providence, Rhode Island, were used to determine monthly frequency curves, as shown on Plate No. 5, for all 1-hour storms. The intensities of the storms of 10 percent chance of occurrence, by months, were used.

C. RUN-OFF. - The areas of the various types of developments in the total drainage area were summated, and appropriate run-off coefficients, for winter and summer seasons, were assumed for each type of development. Run-off coefficients for the entire area were computed, for winter and summer seasons, by weighting each of the above run-off coefficients according to its area. The run-off coefficients selected for the various types of developments, for the two seasons of the year, and the computed weighted run-off coefficients under present and probable future development are shown in the following tables.

RUN-OFF COEFFICIENTS - PRESENT DEVELOPMENT

Type / Season	Run-off coefficient: Fully developed commercial 105 acres 20%	Partially developed industrial 98 acres 18%	Fully developed residential 175 acres 33%	Partially developed residential 156 acres 29%	Weighted run-off coefficient 534 acres 100%
November through April	.80	.40	.60	.40	.54
May through October	.75	.20	.40	.20	.37

RUN-OFF COEFFICIENTS - PROBABLE FUTURE DEVELOPMENT

Type / Season	Run-off coefficient: Fully developed commercial 91 acres 21%	Partially developed industrial 98 acres 22%	Fully developed residential 175 acres 40%	Partially developed residential 73 acres 17%	Weighted run-off coefficient 437 acres 100%
November through April	.80	.40	.60	.40	.56
May through October	.75	.20	.40	.20	.39

To determine the run-off from the area for present and probable future development, the following formula was used:

$$Q = C\ I\ A$$

where: Q = discharge from the total drainage area in cubic feet per second;

C = the weighted run-off coefficient under present and probable future developments;

I = intensity, in inches per hour, of the 1-hour storm with a 10 percent chance of occurrence, by months;

A = total drainage area tributary to the pumping station in acres.

D. RIVER STAGE. - Monthly Connecticut River stage frequency curves, shown on Plate No. 6, were determined at Springfield, Massachusetts, from stage records covering the 68-year period from 1872 to 1939. From these curves the 10 percent chance of occurrence and the 0.10 percent chance of occurrence stages were determined, by months. Plate No. 9 shows the stage-duration curve for the Connecticut River at Springfield, Massachusetts.

E. DISCHARGE CAPACITY. - For the purpose of determining the pumping capacity required, it was assumed that the full storm run-off of the 1-hour storm with a 10 percent chance of occurrence, by months, would occur at the same time that the stage of the river was at the 10 percent chance of occurrence, occurring in the same month. It was further assumed that 40 percent of the storm run-off of the 1-hour storm with a probable chance of occurrence of 10 percent, by months, would occur coincidental with a river stage of 0.10 percent chance of occurrence. The following table shows the relationship between river stage and run-off, under present and probable future developments.

(Table on following page)

RUN-OFF VS. RIVER STAGE

PRESENT DEVELOPMENT (AREA = 534 ACRES)

Month	1-hour 10-year intensity (in. per hour)	Weighted run-off coefficient	Run-off (c.f.s.)	10-year stage (ft. above m.s.l.)	1000-year stage (ft. above m.s.l.)	40% of run-off (c.f.s.)
Jan.	.55	.54	158	49.6	56.4	63
Feb.	.44	.54	127	48.5	55.1	51
March	.44	.54	127	54.3	67.3	51
April	.50	.54	144	55.3	62.4	58
May	.62	.37	123	51.8	59.8	49
June	.94	.37	185	47.7	54.1	74
July	1.40	.37	276	45.8	54.1	110
Aug.	1.20	.37	238	44.7	51.6	95
Sept.	.99	.37	195	46.2	64.3	78
Oct.	.68	.37	134	47.3	59.3	54
Nov.	.54	.54	156	47.8	62.0	62
Dec.	.50	.54	144	49.7	58.3	58

PROBABLE FUTURE DEVELOPMENT (AREA = 437 ACRES)

Jan.	.55	.56	135	49.6	56.4	54
Feb.	.44	.56	108	48.5	55.1	43
March	.44	.56	108	54.3	67.3	43
April	.50	.56	122	55.3	62.4	49
May	.62	.39	106	51.8	59.8	42
June	.94	.39	160	47.7	54.1	64
July	1.40	.39	238	45.8	54.1	95
Aug.	1.20	.39	204	44.7	51.6	82
Sept.	.99	.39	169	46.2	64.3	68
Oct.	.68	.39	116	47.3	59.3	46
Nov.	.54	.56	132	47.8	62.0	53
Dec.	.50	.56	122	49.7	58.3	49

The required pumping capacity for the present and probable future developments is determined by the envelope curve through the above computed points, as shown on Plate No. 10. The maximum required capacity is that at the minimum pumping elevation of 50 feet above mean sea level. For the present development the required pumping capacity is 198 cubic feet per second at minimum stage, and 68 cubic feet per second at maximum stage; for the probable future development the required pumping capacity is 174 cubic feet per second at minimum stage, and 57 cubic feet per second at maximum stage.

F. DISCUSSION. - As previously mentioned, it is probable, in the future, that the storm run-off from Area II, shown on Plate No. 1, will be diverted to the ox-bow pond, thus reducing the contributing area to 437 acres. With this reduction in area, the maximum required pumping capacity of 198 cubic feet per second would be reduced to 174 cubic feet per second. If sufficient sewer facilities were available, or, if there were evidence, beyond the present construction, that the existing sewer facilities would be extended or enlarged to accommodate the 1-hour storm having a probable chance of occurrence of 10 percent, it would be necessary to provide a pumping capacity of 174 cubic feet per second. However, since there is no evidence that additional capacity will be provided, and since the total capacity of the existing sewer system is only 90 cubic feet per second, the present pumping capacity need be only slightly in excess of the existing sewer capacity with the provision for a mechanical safety factor.

G. SUMMARY. - Because of the limited capacity of the present sewer system, a pumping capacity, at the minimum head, of 100 cubic feet per second will be provided to accommodate the present storm run-off from this area. To provide for dry-weather flow, a pump of 16 cubic feet per second capacity will be installed. To provide for future increases in sewer capacity, space will be left in the pumping station for an additional pump which may be varied in size to fit either the maximum pumping capacity of 198 cubic feet per second, or the maximum capacity with a reduced drainage area as discussed in Paragraph F.

VI. MECHANICAL DESIGN

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A. PUMP DRIVE. - The Bridge Street Pumping Station is one of three pumping stations to be constructed in West Springfield, Massachusetts. Prior to the design of any of the stations an investigation was made of the available electric power facilities with the view of employing electric motors for operating the pumps. There are no central stations of public utilities located in West Springfield. The town is served by the electric power lines of the United Electric Light Company which has generating facilities located across the Connecticut River at Springfield, Mass.

Owing to the fact that the past record of the existing power system demonstrates that the existing power supply cannot be depended upon during time of stress and that there are no other available nearby sources of power, it was decided to use gasoline engines for driving the pumps. In addition, the Town of West Springfield has maintained and operated three sewage pumping stations; two of which use an electric motor and one (the latest) a gasoline engine. Predicated on their operating experience the town officials have requested that the pumps for the Bridge Street Pumping Station be driven by gasoline engines.

The gasoline engines for the Bridge Street Pumping Station will be of the heavy-duty industrial type capable of continuously driving the pumps at their rated speed under any head condition developed. The engines will not use over 85 percent of their developed horsepower. They will be mounted on concrete bases and directly connected through flexible couplings to the right angle gear units.

The 16-inch sewage pump will be operated by an electric motor utilizing commercial power. This type of drive was adopted as most suitable because the pump will be operated for extended periods of time and an electric motor drive can be maintained and operated with little difficulty. The motor will be of the wound rotor induction type with control arranged to provide for 1/2, 3/4 and full speeds. This type was employed to reduce the size of the gasoline-electric standby unit and to eliminate stop-and-start operation under low flows. Should the commercial power supply fail, power for operation of the pump will be obtained from the gasoline-electric standby unit.

B. PUMPS. - From the ultimate required pumping capacity of 198 c.f.s. as determined in Section 5, it was determined that provisions should be made to install four pumps. To install a larger number of pumps would materially increase the cost of the station without resulting in any great advantage and a smaller number would seriously limit the operating flexibility and reliability of the station. Inasmuch as the present pumping requirements are considerably less than that required in the future, only three pumps will be installed initially.

No provisions were made in the capacity determined in Section 5 for possible mechanical failure of equipment. To provide for this contingency, it is considered necessary that any three pumps should be capable of delivering about 80 percent of the 198 c.f.s. or 158 c.f.s. This factor will make an ultimate station capacity with four pumps operating at full efficiency, of 212 c.f.s. A study of equipment indicated that four 30-inch propeller type pumps would be required; each pump to have a capacity of 24,000 g.p.m., or 53 c.f.s., against a total head of 12.5

feet. In addition, one 16-inch mixed flow type of pump having a capacity of 6500 g.p.m. against a total of 22.5 feet was provided to pump the dry weather flow and dike seepage at such periods when the river is at flood stage and no storm water is to be pumped from within the protected area.

C. RIGHT ANGLE GEAR UNITS. - The gear units will be of the self-contained type designed for transmitting the power from the horizontal engine shaft through a gear train to the vertical pump shaft. The units will be inclosed in a cast iron and structural steel housing and will have a service factor of not less than 1.25 times the maximum power required to drive the pumps under any condition of head.

D. STANDBY GENERATOR UNIT. - A gasoline engine-driven generator will be provided to furnish electric power in the event of failure of commercial power. The unit will have a normal full load capacity of 93.8 kva, which will be sufficient to start and run the 16-inch pump motor as well as maintain in operation the other electrical auxiliaries and the station lighting system.

E. CRANE. - A five-ton overhead crane will be installed in the engine room to facilitate the repairing of any item of equipment. The crane will be of standard construction and hand operated throughout.

F. SLUICE GATES. - A motor-operated sluice gate will be located at the entrance to the pump sump. This gate will normally be kept closed to prevent water from collecting in the sump. It will be opened only at such periods when it is necessary to operate the storm water pumps. A second motor-operated sluice gate will be located in the gravity discharge conduit to prevent back flow during periods of high water. This gate will normally be kept open to permit water to flow by gravity to the river.

G. WATER SYSTEM. - The city water supply will be connected to the pumping station and the water used for cooling the gasoline engines and station service. In addition, the sump pump will be so connected that it can be employed to furnish engine-cooling water in times of emergency.

H. GASOLINE SYSTEM. - Gasoline will be stored in a 3200 gallon tank buried in the ground adjacent to the pumping station. Each engine will be supplied through an individual line running directly to the tank. Drip pans will be provided on each engine and connected to a common header running back to the tank. All gasoline pipe will be 3/4-inch, I. D. copper tubing with flared joint connections. At such points where the gasoline lines are imbedded in concrete or pass through beams, they will be protected by wrought iron pipe sleeves.

I. SUMP PUMP. - A motor-operated sump pump of 50 g.p.m. capacity will be provided in the wet sump for the purpose of drying it up after the pumping station has been in operation.

J. VALVES. - A flap valve will be installed on the end of each pump discharge line to facilitate the starting of the pump and to prevent backflow through it when the river is at flood stage. Intermittent starting and stopping of the pumps will, however, subject the flap valves to considerable slamming which in time may result in their failure. In view of this fact, a gate valve will be provided in each discharge line so that they may be closed should a flap valve fail.

K. FIRE EXTINGUISHING SYSTEM. - A carbon dioxide fire extinguishing system will be installed and so arranged that any gasoline engine can be blanketed with gas by tripping a valve located just inside the main entrance to the building. Portable extinguishers will be provided to take care of any other emergencies.

L. HEATING SYSTEM. - The heating system will be of the two pipe gravity type consisting of an oil-fired boiler supplying steam to two unit heaters located at opposite ends of the engine room. The oil burner will be of the rotary type with electric ignition. The unit heaters will be of ample capacity to heat the engine room under the coldest weather condition.

M. SWITCHBOARD AND CONTROL EQUIPMENT. - The switchboard will be of the steel-enclosed, low-voltage, dead-front, light duty type with all controls mounted on the front. All circuit breakers will be manually operated. Circuit breakers for the generator and incoming feeder will be the air-break type rated at 600 volts, 60-cycles, A.C., having an interrupting capacity of 20,000 amperes, provided with three instantaneous and time-delay magnetic overcurrent trips, and mechanically interlocked so that only one can be in the closed position at any time. This lockout feature will be provided to prevent the connection of the standby generator in parallel with the outside source.

All controls for operating the 16-inch pump motor will be located at the switchboard in order to centralize them with those of the outside source and standby generator. The external resistance of the rotor will be varied through a drum controller to provide speed regulation at one-half, three-quarters, and full load speeds. The speed reduction will be used to provide continuous operation during periods when the flow to the pump is less than full load capacity at rated speed. The secondary resistors will be mounted on the wall to allow free circulation of air for dissipating the heat generated. The primary of the pump motor will be controlled by a magnetic contactor, fed from the main bus through a feeder circuit breaker, interlocked with the "off" position of the drum controller so the motor cannot be started without having all of the resistance in the rotor circuit at the time of starting. Feeder protective circuit breakers for the pumping station auxiliary equipment will be mounted on the switchboard, and each circuit breaker will be rated at 600 volts, 60 cycles, A.C., having an interrupting capacity of 10,000 amperes and provided with thermal and instantaneous magnetic trip relays.

VII. STRUCTURAL DESIGN

VII. STRUCTURAL DESIGN

A. SPECIFICATIONS FOR STRUCTURAL DESIGN.

1. General. - The structural design of the Bridge Street Pumping Station has been executed in general in accordance with generally accepted standard practice. The specifications which follow cover the design assumptions used and other conditions affecting the design of the reinforced concrete and structural steel.

2. Unit weights. - The following unit weights for material were assumed in the design of the structure:

Water	62.5# per cubic foot
Dry earth	100 # " " "
Saturated earth	125 # " " "
Concrete	150 # " " "

3. Earth pressures. - For computing earth pressure caused by dry earth Rankine's formula was used. For saturated soils an equivalent liquid pressure of 80 pounds per square foot per foot of depth was assumed.

4. Structural steel. - The design of structural steel was carried out in accordance with the Standard Specifications for Steel Construction for Buildings of the American Institute of Steel Construction.

5. Reinforced concrete. - In general, all reinforced concrete was designed in accordance with the "Joint Committee on Standard Specifications for Concrete and Reinforced Concrete" issued in January 1937.

a. Allowable working stress. - The allowable working stress in concrete used in the design of the pump house and appurtenant structures is based on a compressive strength of 3,000 pounds per square inch in 28 days.

b. Flexure (f_c). -	Lbs. per sq. in.
Extreme fibre stress in compression	800
Extreme fibre stress in compression adjacent to supports of continuous or fixed beams or rigid frames	900
c. Shear (v). -	
Beams with no web reinforcement and without special anchorage.	60
Beams with no web reinforcement but with special anchorage of longitudinal steel	90
Beams with properly designed web reinforcement but without special anchorage of longitudinal steel.	180
Beams with properly designed web reinforcement and with special anchorage of longitudinal steel	270
Footings where longitudinal bars have no special anchorage	60
Footings where longitudinal bars have special anchorage	90
d. Bond (u). -	
In beams, slabs, and one way footings	100
Where special anchorage is provided	200
The above stresses are for deformed bars.	
e. Bearing (f_c). -	
Where a concrete member has an area at least twice the area in bearing	500

	Lbs. per sq. in.
f. Axial compression (f_c).	
Columns with lateral ties	450
g. Steel stresses. -	
Tension	18000
Web reinforcement	16000

h. Protective concrete covering. -

Type of members	Minimum cover in inches
Interior slabs	1-1/2
Interior beams	2
Members poured directly against the ground . . .	4
Members exposed to earth or water but poured against forms	3

For secondary steel, such as temperature and spacer steel, the above minimum cover may be decreased by the diameter of the temperature or spacer steel rods.

B. BASIC ASSUMPTIONS FOR DESIGN. -

1. Roof slab. - The roof slab is of reinforced concrete. It is designed to carry the full dead load plus a live load of 40# per square foot of roof surface.

2. Roof beams. - The roof beams are of structural steel encased in concrete fireproofing. They are designed to carry the full dead load, plus the full live load of 40# per square foot of roof surface. In addition to taking up the roof load, these beams together with the columns to which they are connected, form portal frames which take up wind load and

crane thrusts on the building. The end connections are designed to take up all such horizontal loads.

3. Columns. - a. Structural steel columns in the side walls and end walls of the superstructure take up the direct roof loads as well as all wind loads on the sides of the superstructure. In addition, the columns in the side walls carry crane brackets which support the crane runway. These columns are designed to carry full live and dead load from the roof; dead load, live load, and impact effect from the traveling crane; bending due to eccentrically applied loads, and bending due to wind load on the building. No point of inflection was considered in the column design, a pin-ended condition at the base being assumed.

b. Wall columns in the ends of the building were designed for full dead load and live load from roof, plus wind load on the building.

c. Allowable stress in columns was figured from formula

$$P/A = \frac{18,000}{1 + \frac{l^2}{18,000\, r^2}}$$

with a maximum allowable stress of 15,000 # per square inch for dead load plus live load, and a maximum allowable stress of 20,000 # per square inch for combined dead load, live load, and wind load; l/r limited not to exceed 120.

4. Engine room floor. - The engine room floor is designed to carry all engines, motors, etc., actually to be placed on that floor, as well as a uniform load.

The following assumptions were made for design purposes:

a. For the floor slab, the design loads are the estimated dead loads plus a uniform live load of 300 # per square foot.

b. For the removable steel floor plates, the design loads are the estimated dead load plus a uniform load of 300# per square foot.

c. For the floor beams, the design loads are the estimated dead loads, the actual machinery loads, a concrete base slab load under the gasoline engines, and a uniform load of 200# per square foot on the unoccupied portion of the floor slabs which contribute loads to the beams under consideration. For the machinery loads, an impact factor of 100 percent has been added.

5. Pump room side walls. -

a. The station is so located that the building forms a part of the flood protection. The riverside wall and the end walls are designed of reinforced concrete below elevation 66.75 and of brick and steel construction above elevation 66.75. The landside wall is designed of brick and steel construction above elevation 65.00 and reinforced concrete below elevation 65.00.

b. In designing the wet pump room side walls, account was taken of the effect of the thrust of the water against the building with the river at flood stage. To provide for horizontal pressures the walls were designed simply supported at the operating floor level and continuous with the base slab. At the operating floor level the walls are supported by the floor slab acting as a horizontal girder which transfers the reactions into the end wall and the division wall between the wet sump and 16-inch pump rooms.

c. In the 16-inch pump room, the riverside wall, the landside wall, the end wall and the wall between the wet sump and the 16-inch pump room were designed as a rigid horizontal frame.

d. The portion of the riverside wall, extending from the engine room floor to elevation 66.75 was designed as a cantilever wall.

e. The loading consisted of the vertical loads due to the weight of the structure; the vertical live and impact loads from the engine room floor; the roof live load; and the thrusts against the walls from high water on the riverside and earth pressures on the landside.

From the loadings noted, bending moments were computed in the walls, pump room floor slab and engine room floor beams.

6. Pump room end walls. - The pump room end walls were designed to resist the vertical loads, and thrusts due to earth pressure.

7. Boiler room floor. - The boiler room floor was designed for a uniform live load of 250 #/sq. ft. plus the dead weight of slab. In designing the boiler room floor beams the live load was reduced to 200 #/sq. ft.

8. Conduit. - The conduit is designed only for gravity flow. It is a rectangular chamber, 5' x 6', and approaches from the south and passes along the east end of the pumping station. When the river is down the flow is discharged through the conduit directly into the river. With the river up, the flow from the conduit is diverted into the pumping station through a trash rack chamber where the flow is screened before entering the pumps. The trash rack chamber and conduit were designed as continuous box sections. The trash rack chamber was also designed to carry a type H-12 truck load on the roof. An expansion joint is provided between the trash rack chamber and the pump house substructure. The conduit at the east end of the pump house is part of the substructure and the

expansion joints are at the outside edges of the substructure base slab.

9. Trash racks. - There is one trash rack in the trash rack chamber. The rack consists of two leaves which are hinged 8' - 6" vertically above the bottom of the rack and which revolve on a 6-inch diameter pipe acting as a pin or trunnion. The rack can be raised into a horizontal position for cleaning. Cast iron bearings in the chamber side walls provide support for the pipe trunnion while cast iron stops anchored into the conduit floor slab hold the rack in alignment when it is in position for screening.

10. Stairways and ladders. - An open grating stairway leads from the engine room floor to the boiler room and then to the 16-inch pump room. Access to the wet sump is obtained through a hatch in the engine room floor and also by means of a concrete stairway. A steel ladder is provided on the west face of the building for access to the roof.

C. ARCHITECTURE. - The pumping station will be a building of modern design in keeping with the architectural treatment used on similar projects of the Providence District elsewhere on the Connecticut River. This design will give a pleasing appearance without undue emphasis being placed on purely decorative features.

The pumping station will have a concrete substructure with a flat-roofed, brick and structural steel superstructure 24' x 60' overall in area. The 12.5 inch thick brick walls, capped with a cast stone coping, extend above the roof slab to form a parapet wall around the entire roof. A flat type roof was chosen as being economical, in keeping with the architectural design, and to serve as a location for the engine exhaust mufflers. The roof system consists of steel beams encased in concrete and supported by steel columns. The roof slab will be 5 inches thick, covered with a cinder concrete fill sloped to drain. There are no outside pilasters. Inside the building there are pilasters at each structural steel column, forming fire-proof column encasements. The operating room floor will be an 8-1/2-inch structural concrete slab, with a monolithic finish. A hand-operated traveling crane of 5 tons lifting capacity will operate for the full length of the building and will be used for installing and for use in repairing pumps and machinery. Access for the crane hoist to the 16-inch pump and wet sump rooms will be through openings in the engine room floor, these openings being normally covered with removable checkered floor plates.

There is no window sash in the building. Light will be admitted through glass block panels. These are used because of the exposed location of the pumping station near the river bank, making ordinary windows somewhat undesirable. In addition, the well diffused and uniform light which they provide and their appearance is also in keeping with the spirit of the architectural design. To provide ventilation, adjustable louvres have been placed low in the brick walls and a motor operated exhaust ventilator has been placed on the roof. Two doors give access to the building. The main entrance door, 5 feet wide and 8 feet high, consists of two leaves of hollow steel construction and give entrance directly to the engine room floor. It is large enough to provide adequate clearance for any replacement of mechanical equipment which may be required in the future. The small hollow steel door on the west end of the building provides a service passage.

VIII. CONSTRUCTION PROCEDURE

VIII. CONSTRUCTION PROCEDURE

A. SEQUENCE OF OPERATIONS. - The schedule of work will require the contractor to complete the pumping station and appurtenant works in 250 calendar days after receipt by the contractor of notice to proceed.

B. CONCRETE CONSTRUCTION. -

1. Composition of concrete. - The concrete will be composed of cement, fine aggregate, coarse aggregate and water so proportioned and mixed as to produce a plastic, workable mixture. All concrete will be Class A except the pumping station base slab which will be Class B. Class A concrete will have an average compressive stress of not less than 3400 lbs. per square inch in accordance with a standard 28-day test. The average compressive stress for Class B concrete will be 3000 lbs. per square inch in accordance with a standard 28-day test. Concrete aggregates will be of suitable quality and will be tested by the Central Concrete Testing Laboratory of the North Atlantic Division at West Point.

2. Laboratory control. - A small concrete testing laboratory is available in the West Springfield Area of the district for use principally to control the quality of concrete during construction. The tests performed here will supplement those made at the Central Laboratory. Facilities will be available for testing the grading of aggregates, designing concrete mixtures, mixing of trial concrete batches for the purpose of developing actual relations between the compressive strength and the water cement ratio, and the casting of concrete cylinders for compressive strength tests.

a. Cement. - Portland cement of a well known and acceptable brand will be used throughout. The cement will be tested by the Central Laboratory and results of these tests shall be known before the cement is used.

b. Fine aggregate. - Natural sand will be used as a fine aggregate. The aggregate will be subject to thorough analysis, including magnesium sulphate soundness tests, and tests made on mortar specimens for compressive strength.

c. Coarse aggregate. - Washed gravel or crushed stone of required sizes will be used as coarse aggregate. It will consist of hard, tough and durable particles free from adherent coating and will be free from vegetable matter. Only a small amount of soft, friable, thin or elongated particles will be allowed. The aggregate will be subject to thorough analysis, accelerated freezing and thawing tests and to compressive tests in concrete cylinders.

d. Water. - The amount of water used per bag of cement for each batch of concrete will be predetermined; in general, it will be the minimum amount necessary to produce a plastic mixture of the strength specified. Slump tests will be required in accordance with the specifications.

3. Field Control.

a. Storage. - The cement will be stored in a thoroughly dry, weather-tight and properly ventilated building. The fine and coarse aggregates will be stored in such a manner that inclusion of foreign material will be avoided.

b. Mixing. - The exact proportions of all ingredients of the concrete will be predetermined. The mixing will be done in approved mechanical mixers of a rotating type, and there will be adequate facilities for accurate measurement and control of each of the materials used in the concrete. Mixing will be done in batches of sizes as directed and samples will be taken for slump tests and for compressive strength tests. Inspectors will at all times supervise and inspect the mixing procedure.

c. Placing. - Concrete will be placed before the initial set has occurred. Forms will be clean, oiled, rigidly braced and of ample strength. Concrete poured directly against the ground will be placed on clean damp surfaces. Mechanical vibrators will be used and forking or hand spading will be applied adjacent to forms on exposed surfaces to insure smooth, even surfaces. The location of vertical and horizontal construction joints as well as contraction and expansion joints, and the location of copper water stops are indicated on the drawings. The locations of construction joints are tentative and may be changed to suit conditions in the field. Before placing concrete, all reinforcing steel will be inspected and pouring of the concrete will be supervised and directed by Government inspectors. Adequate precautions will be taken if concrete is to be placed in cold or hot weather.

C. STRUCTURAL STEEL CONSTRUCTION. -

1. Superstructure framework. - The superstructure framework consists of beams and columns which will form a skeleton frame for the exterior walls and roof, and will provide a runway for the hand operated crane. The columns will be securely anchored to the substructure concrete walls and will be connected to the roof beams with web connection angles and wind bracing connections. The crane rails will be fastened

to the crane runway beams with bent hook bolts. Crane stops at each end of the runway will prevent the traveling crane from running into the end walls.

2. Stairways. - The stairways consist of open grating treads fastened to structural steel stairway channels with wrought iron pipe railings fastened to the top flanges of the channels.

3. Trash racks. - The trash racks are made up of structural channel frames which support 4" x 3/8" grating bars spaced 2-5/8" in the clear. The racks are welded throughout.

4. Removable floor plates. - Access for the crane to pump room will be obtained by removing checkered floor plates which cover the opening in the engine room floor. The removable covers consist of 1/4-inch checkered plates welded to the 2-1/2" leg of 3" x 2-1/2" x 5/16" angles. The ends are supported on angle frames anchored into the floor concrete. Each opening in the floor is covered with two sections. Lifting handles are provided in the plates for easy removal.

5. Miscellaneous angles and frames. - Miscellaneous structural steel such as door frames, angles, grilles, etc., will be erected and placed as indicated on the drawings and at such time as required.

IX. SUMMARY OF COST

IX. SUMMARY OF COST

The total construction cost of the Bridge Street Pumping Station, including the outlet conduit and mechanical equipment has been estimated to be $135,000, including 10 percent for contingencies and 15 percent for engineering and overhead.

This amount has been distributed as follows:

(1) Pumping Station			
a. Concrete features	$21,500		
b. Superstructure	16,300		
c. Miscellaneous	19,700		
		$57,500.	
(2) Conduit			
a. Concrete features		5,700.	
(3) Mechanical equipment		71,800.	
	Total		$135,000

(1) a. The concrete features included under the pumping station Item (1) a consist of the entrance chamber and building foundation to and including the operating floor slab.

(1) b. The superstructure consists of the complete building above the operating floor.

(1) c. Miscellaneous items are common excavation and backfill for the building, miscellaneous iron and steel trash rack and all other items not included in (1) a and (1) b.

(2) a. The concrete features included under the conduit item (2) a consist of the gravity conduit with outlet headwall and gate structure.

(3) The mechanical equipment consists of the pumps, gasoline engines, electric motor, gear units, crane, generating unit, valves and piping, sluice gates and miscellaneous items.

X. PLATES

ANALYSIS OF DESIGN

BRIDGE STREET PUMPING STATION

INDEX OF PLATES

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY

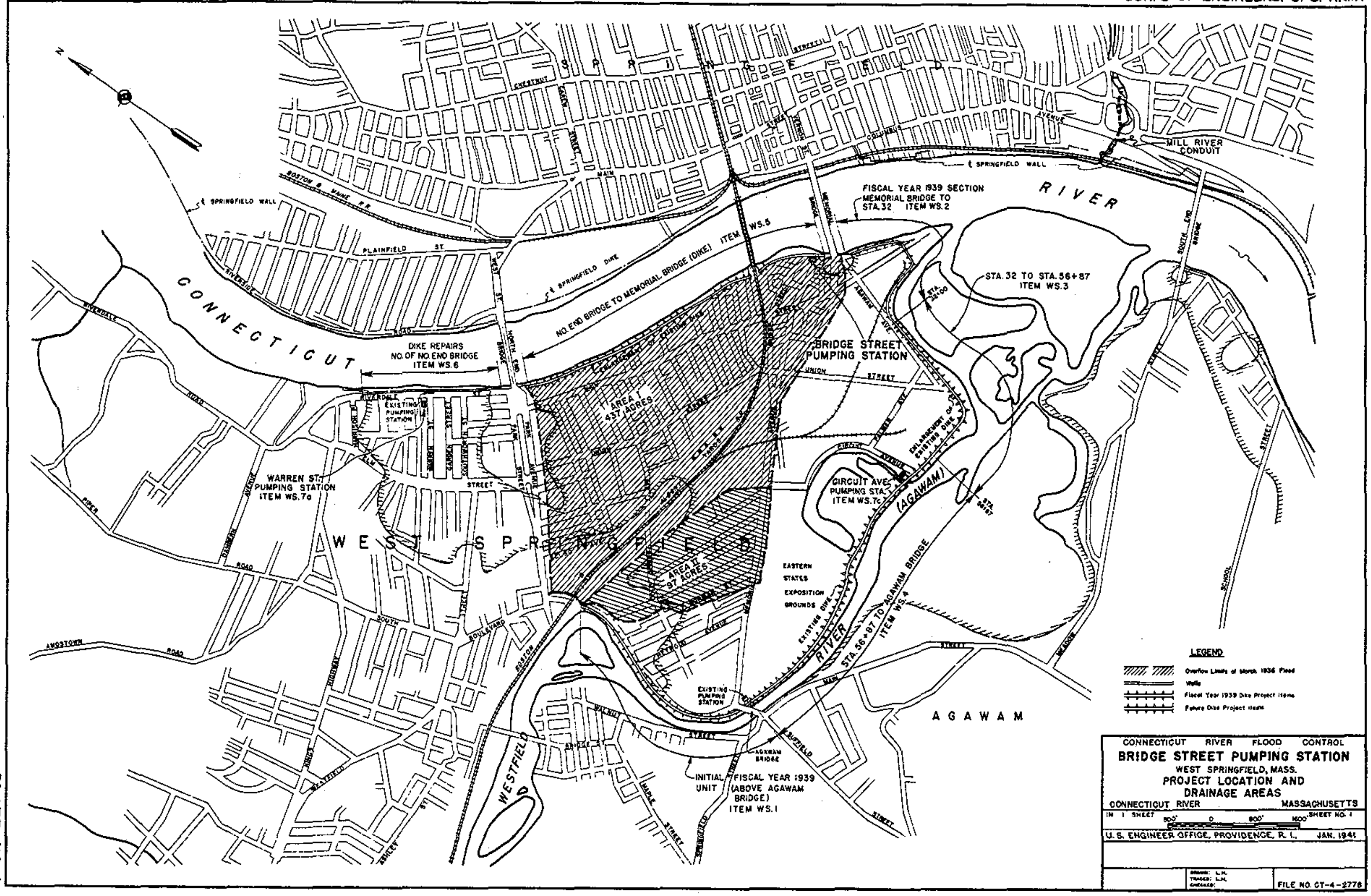
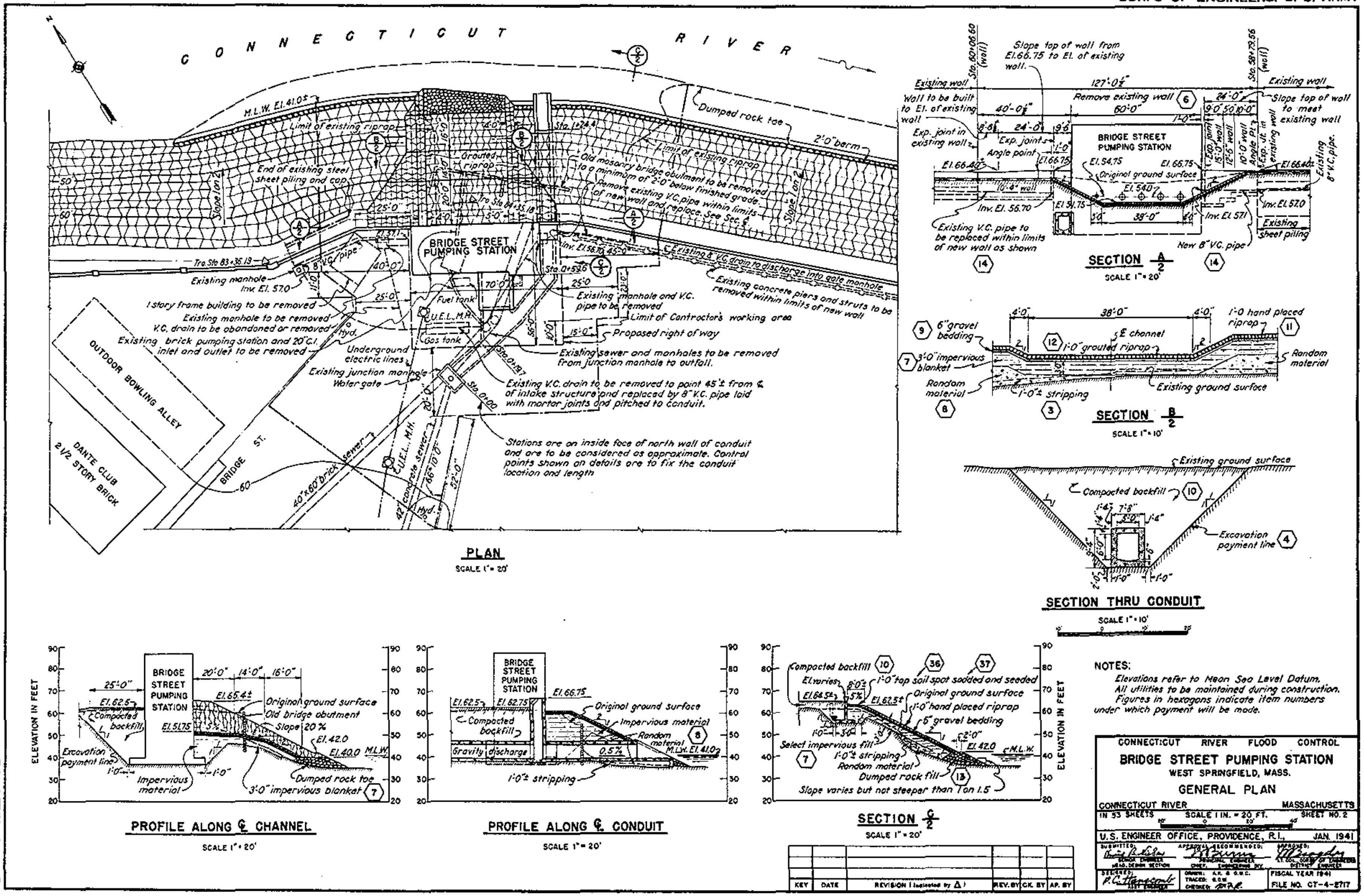


PLATE NO. I

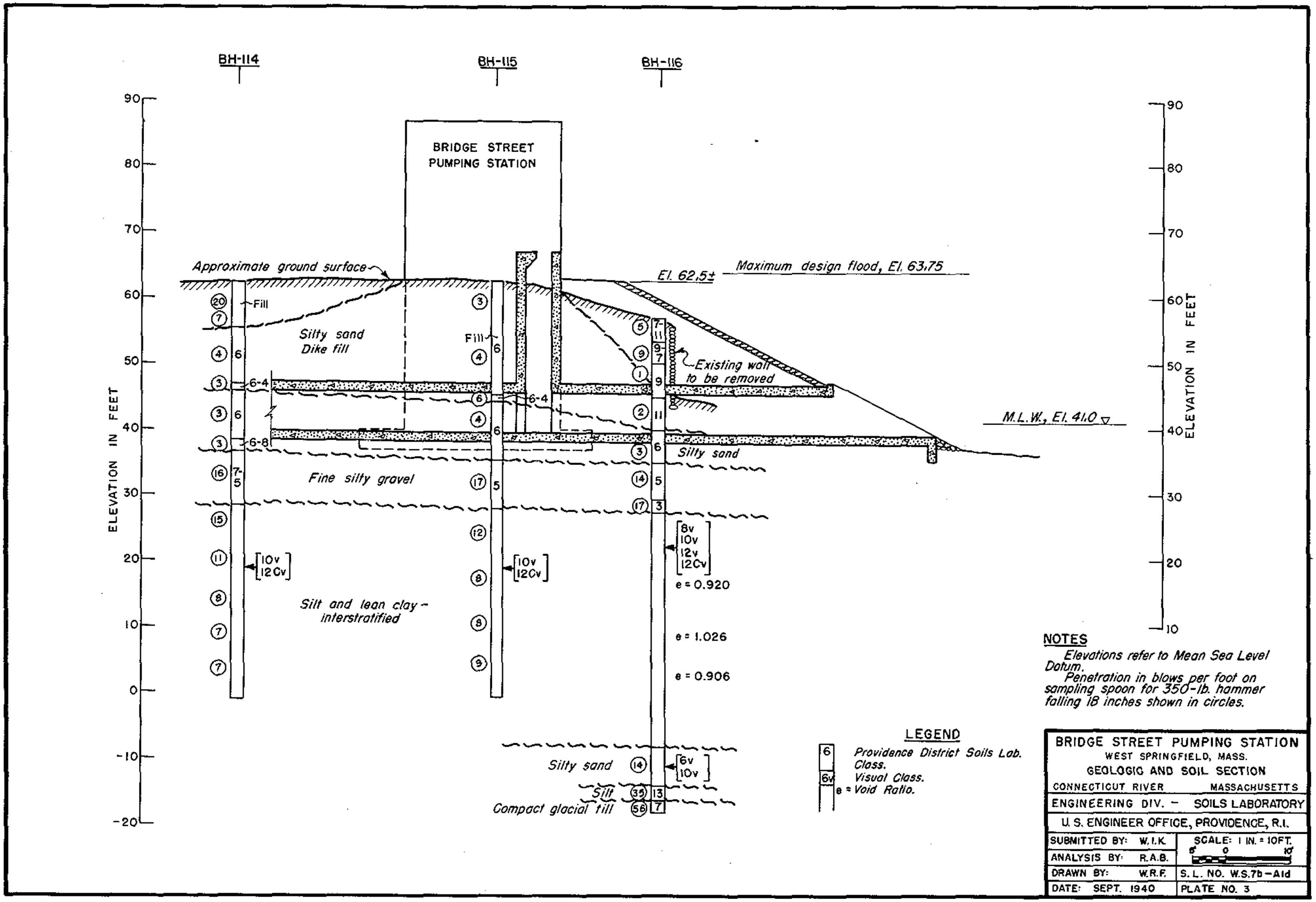
WAR DEPARTMENT

CORPS OF ENGINEERS. U. S. ARMY



WS. 7b

PLATE NO. 2



BH-114
BH-115
BH-116
BRIDGE STREET PUMPING STATION
Approximate ground surface
El. 62.5±
Maximum design flood, El. 63.75
Fill
Silty sand Dike fill
Existing wall to be removed
M.L.W., El. 41.0
Silty sand
Fine silty gravel
Silt and lean clay - interstratified
e = 0.920
e = 1.026
e = 0.906
Silty sand
Silt
Compact glacial till
ELEVATION IN FEET
NOTES
Elevations refer to Mean Sea Level Datum.
Penetration in blows per foot on sampling spoon for 350-lb. hammer falling 18 inches shown in circles.
LEGEND
Providence District Soils Lab. Class.
Visual Class.
e = Void Ratio.
BRIDGE STREET PUMPING STATION
WEST SPRINGFIELD, MASS.
GEOLOGIC AND SOIL SECTION
CONNECTICUT RIVER MASSACHUSETTS
ENGINEERING DIV. - SOILS LABORATORY
U. S. ENGINEER OFFICE, PROVIDENCE, R.I.
SUBMITTED BY: W.I.K.
ANALYSIS BY: R.A.B.
DRAWN BY: W.R.F.
DATE: SEPT. 1940
SCALE: 1 IN. = 10 FT.
S. L. NO. W.S.7b-A1d
PLATE NO. 3

PLATE NO. 3

PROVIDENCE DISTRICT SOIL CLASSIFICATION

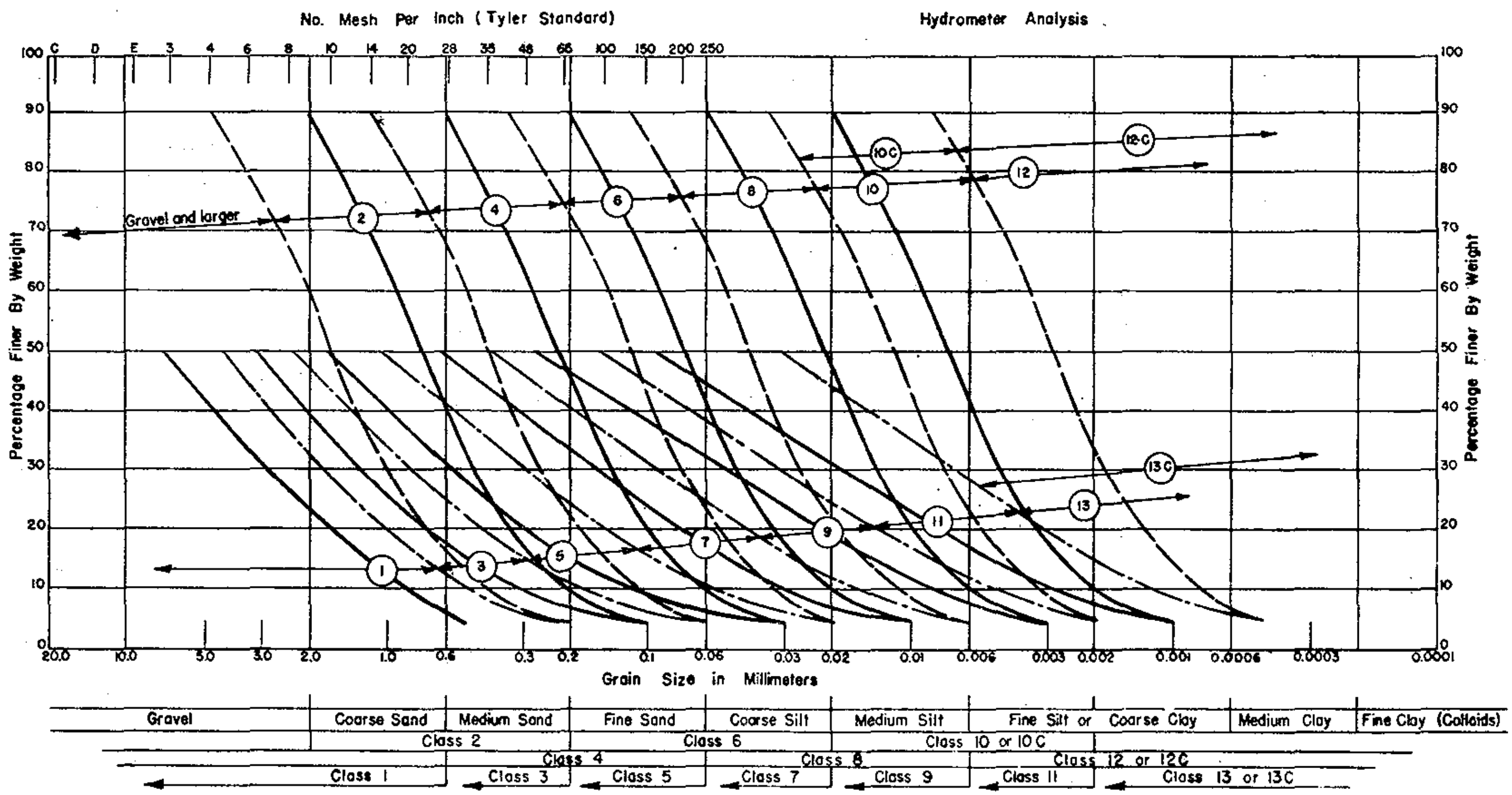
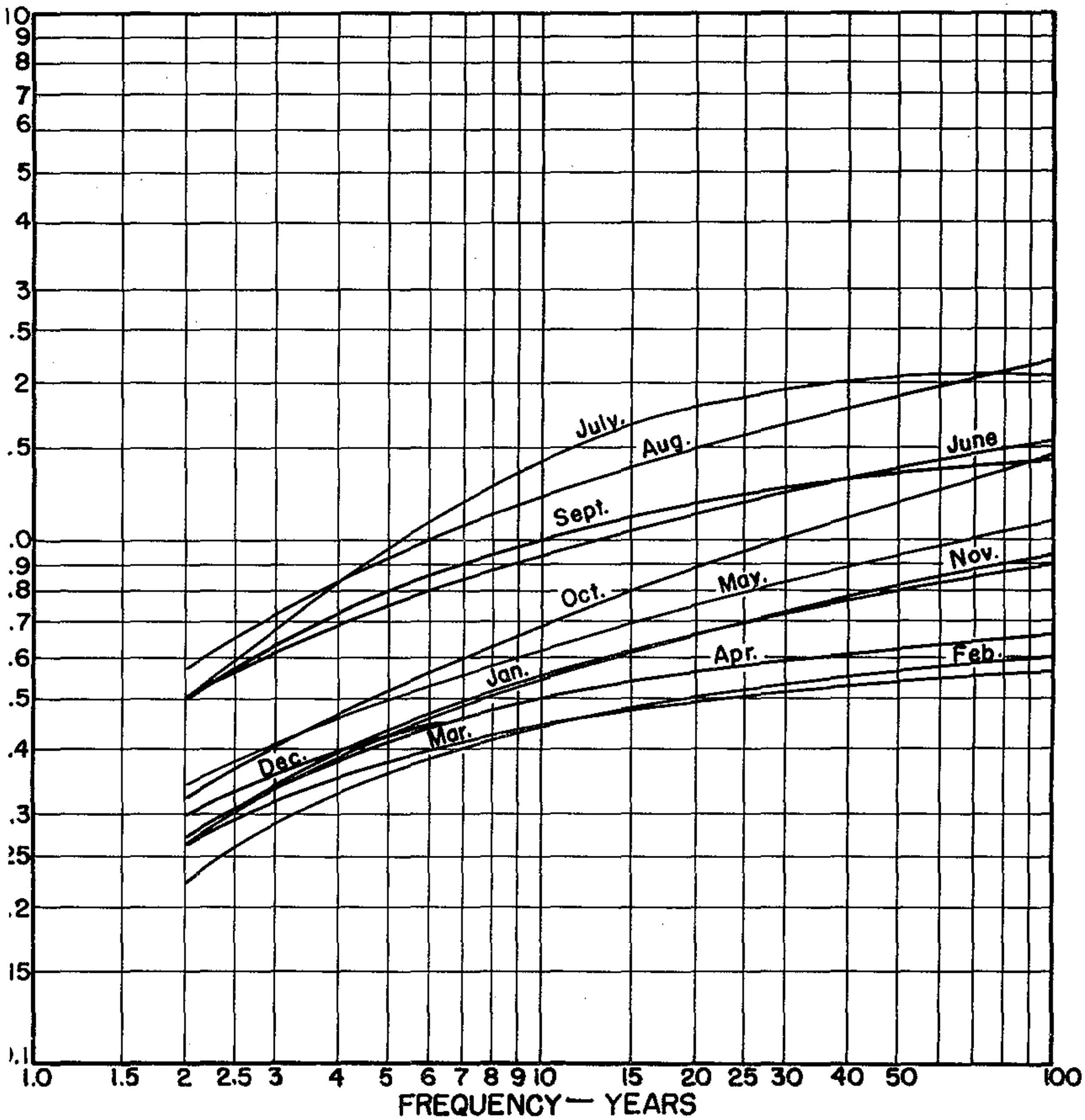


DIAGRAM SHOWING LIMITS OF SOIL CLASSES

PLATE NO. 4



CONNECTICUT RIVER FLOOD CONTROL

BRIDGE STREET PUMPING STATION

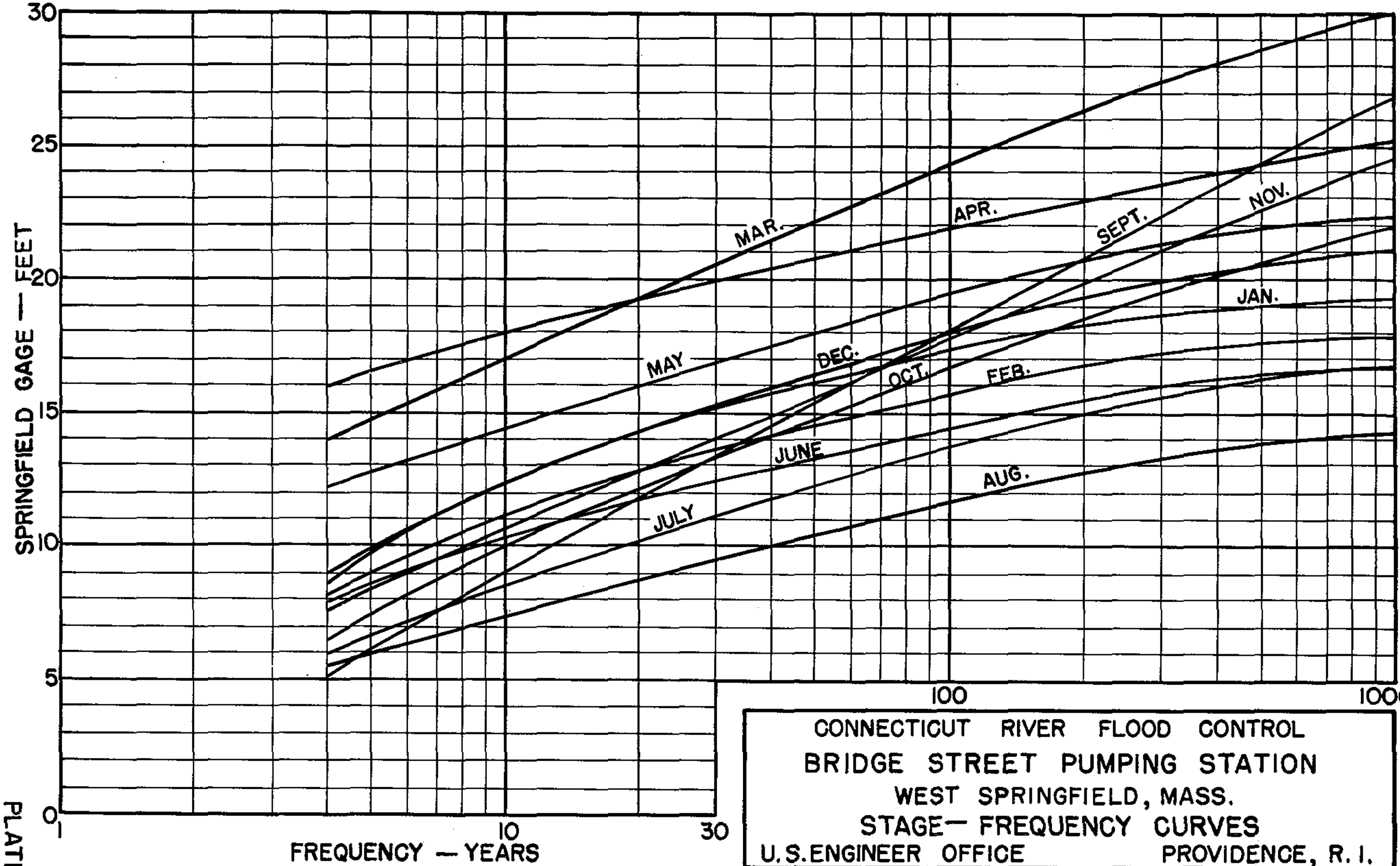
WEST SPRINGFIELD, MASS.

RAINFALL INTENSITY — FREQUENCY CURVES

1- HOUR STORM

U. S. ENGINEER OFFICE PROVIDENCE, R. I.

PLATE NO. 5

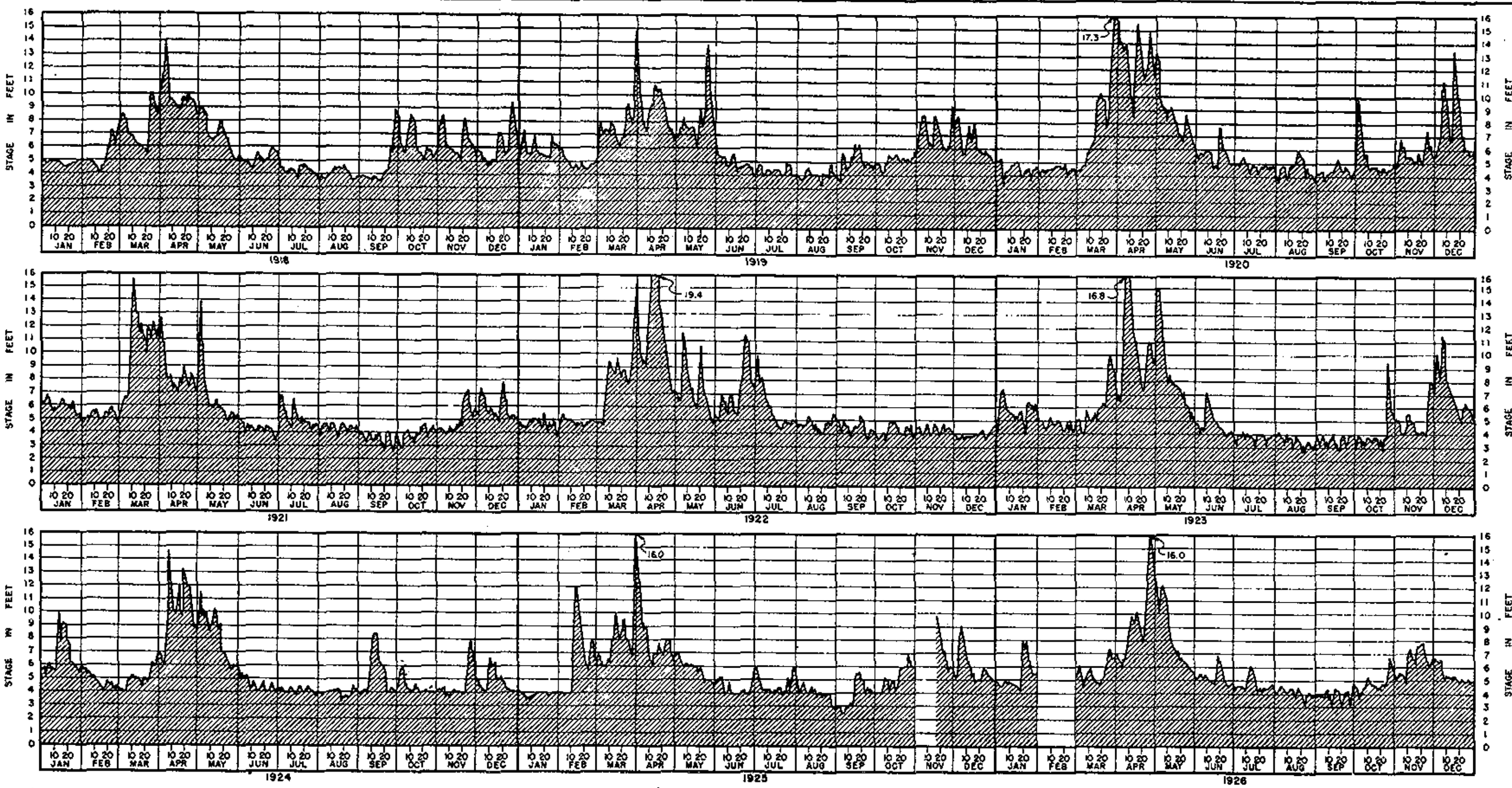


CONNECTICUT RIVER FLOOD CONTROL
BRIDGE STREET PUMPING STATION
WEST SPRINGFIELD, MASS.
STAGE— FREQUENCY CURVES
U.S. ENGINEER OFFICE PROVIDENCE, R. I.

PLATE NO. 6

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



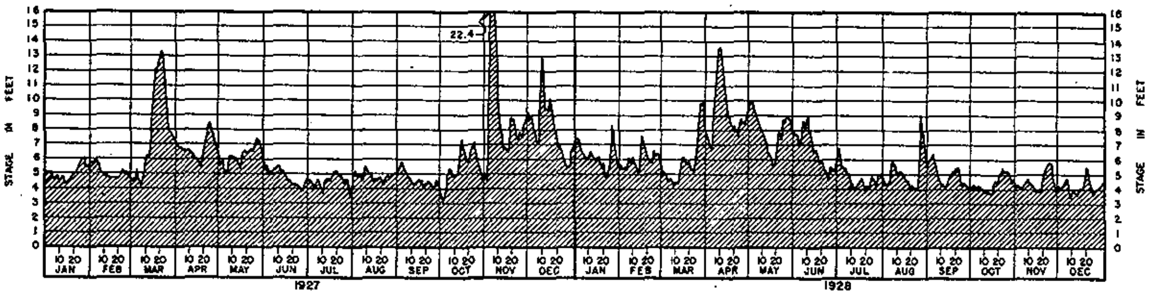


PLATE NO. 7

KEY	DATE	REVISION (Indicated by Δ)	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL

BRIDGE STREET PUMPING STATION

WEST SPRINGFIELD, MASS.

HYDROGRAPH NO. 1

CONNECTICUT RIVER — MASSACHUSETTS

IN 2 SHEETS — SHEET NO. 1

SCALE AS SHOWN

U. S. ENGINEER OFFICE, PROVIDENCE, R. I., JAN. 1941

SUBMITTED: ENGINEER, HEAD, HYDRAULICS SECTION

APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF F. C. ENGINEERING DIV.

APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

COMPILED: ASSOC. ENGINEER

DRAWN: W.C.H. & R.A.L.
TRACED: L.K.R.
CHECKED:

FISCAL YEAR 1941

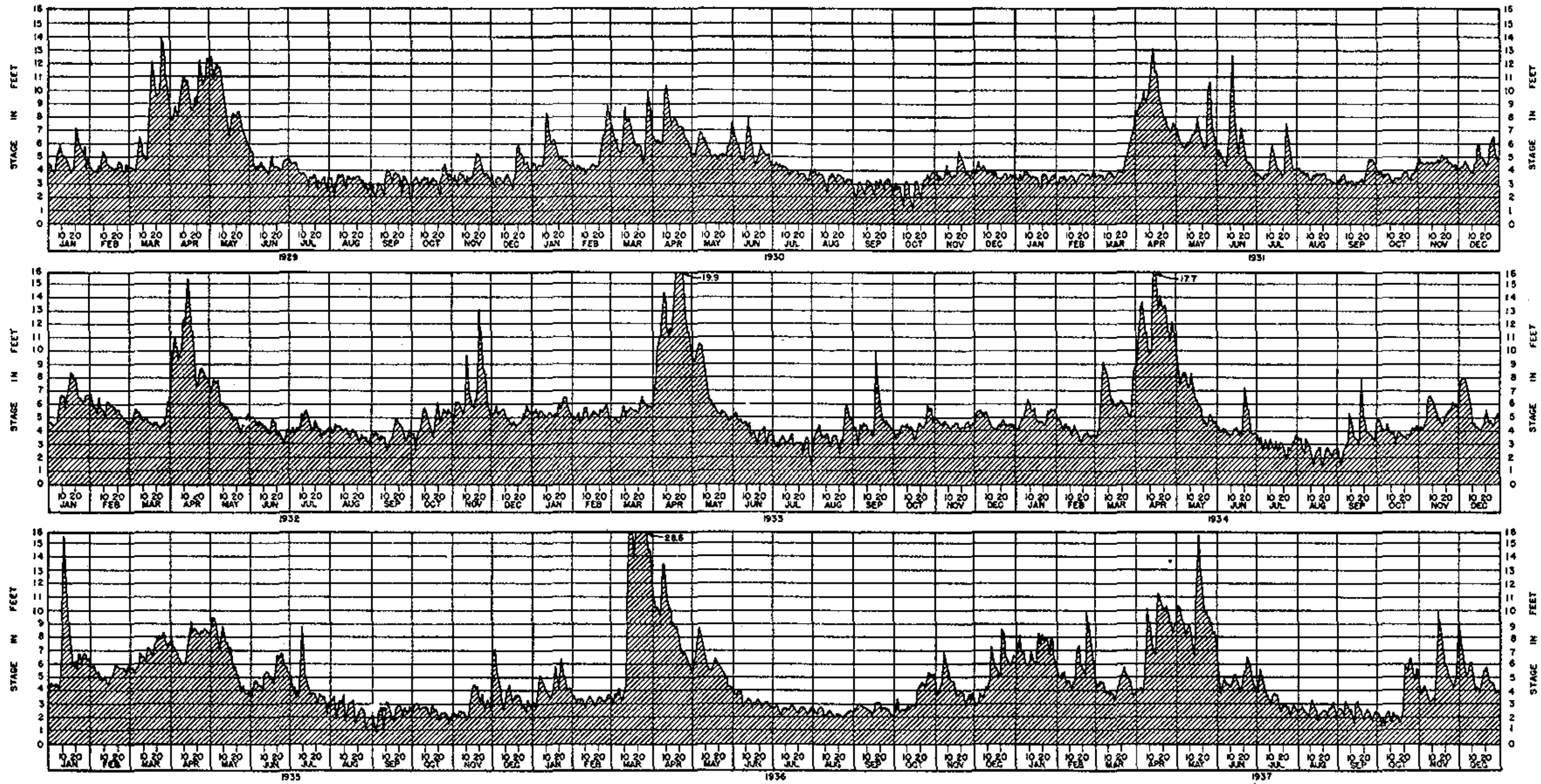
FILE NO. CT-3-1184

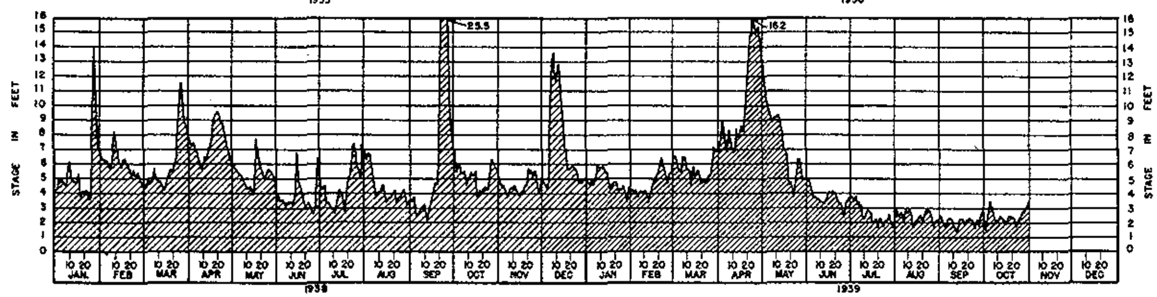
ANALYSIS OF DESIGN

WS-7b

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY





KEY	DATE	REVISION (Indicated by △)	REV.BY	CK.BY	AP.BY

CONNECTICUT RIVER FLOOD CONTROL

BRIDGE STREET PUMPING STATION

WEST SPRINGFIELD, MASS.

HYDROGRAPH NO. 2

CONNECTICUT RIVER — MASSACHUSETTS

IN 2 SHEETS — SCALE AS SHOWN — SHEET NO. 2

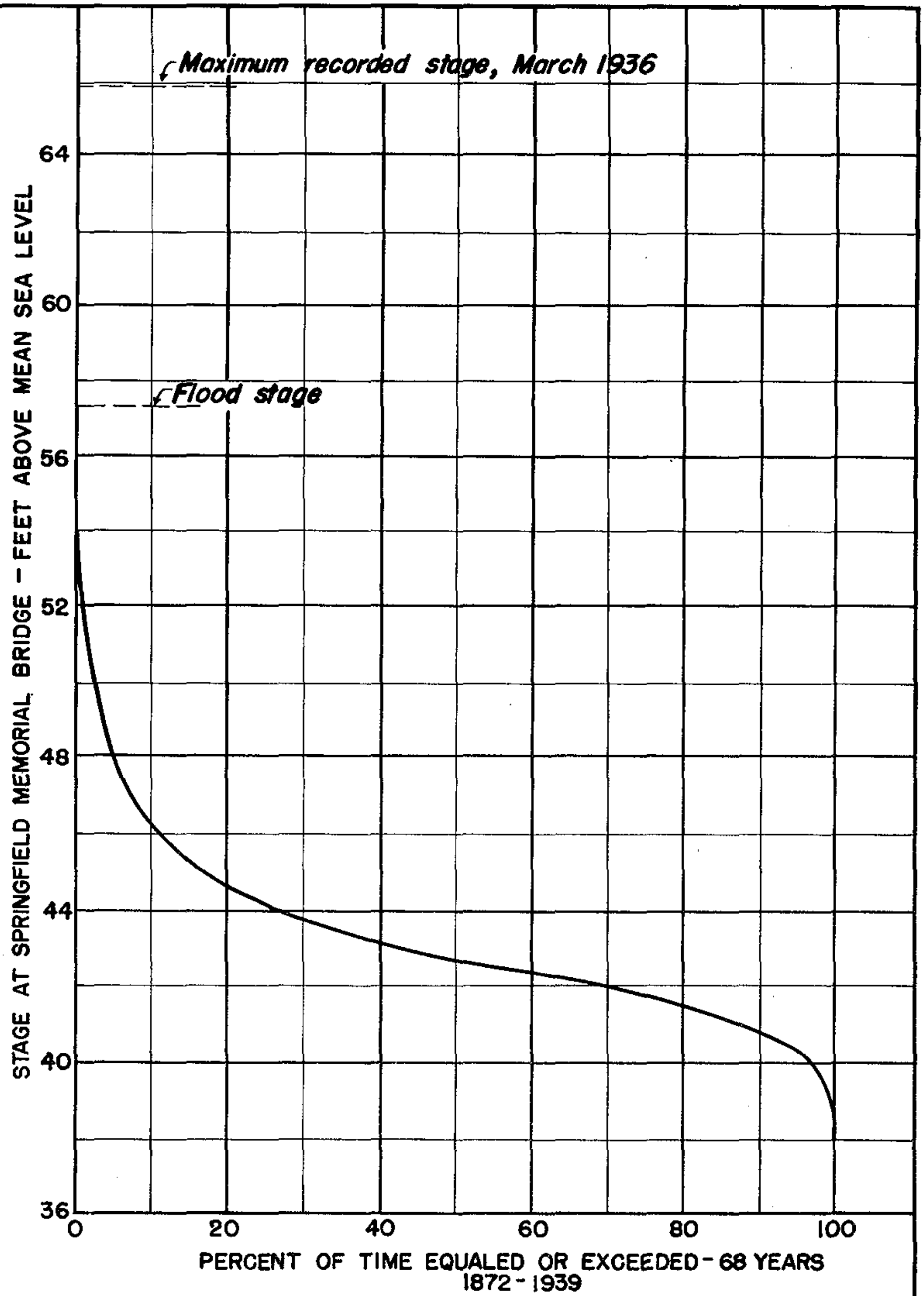
U. S. ENGINEER OFFICE, PROVIDENCE, R. I. — JAN. 1941

SUBMITTED: ENGINEER, HEAD, HYDRAULICS SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF F. C. ENGINEERING DIV — APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

COMPILED: ASSOC. ENGINEER — DRAWN: W.C.H. & G.A.L. TRACED: R.E.K. CHECKED: — FISCAL YEAR 1941 — FILE NO. CT-3-1185

ANALYSIS OF DESIGN — WS. 7b

PLATE NO. 8



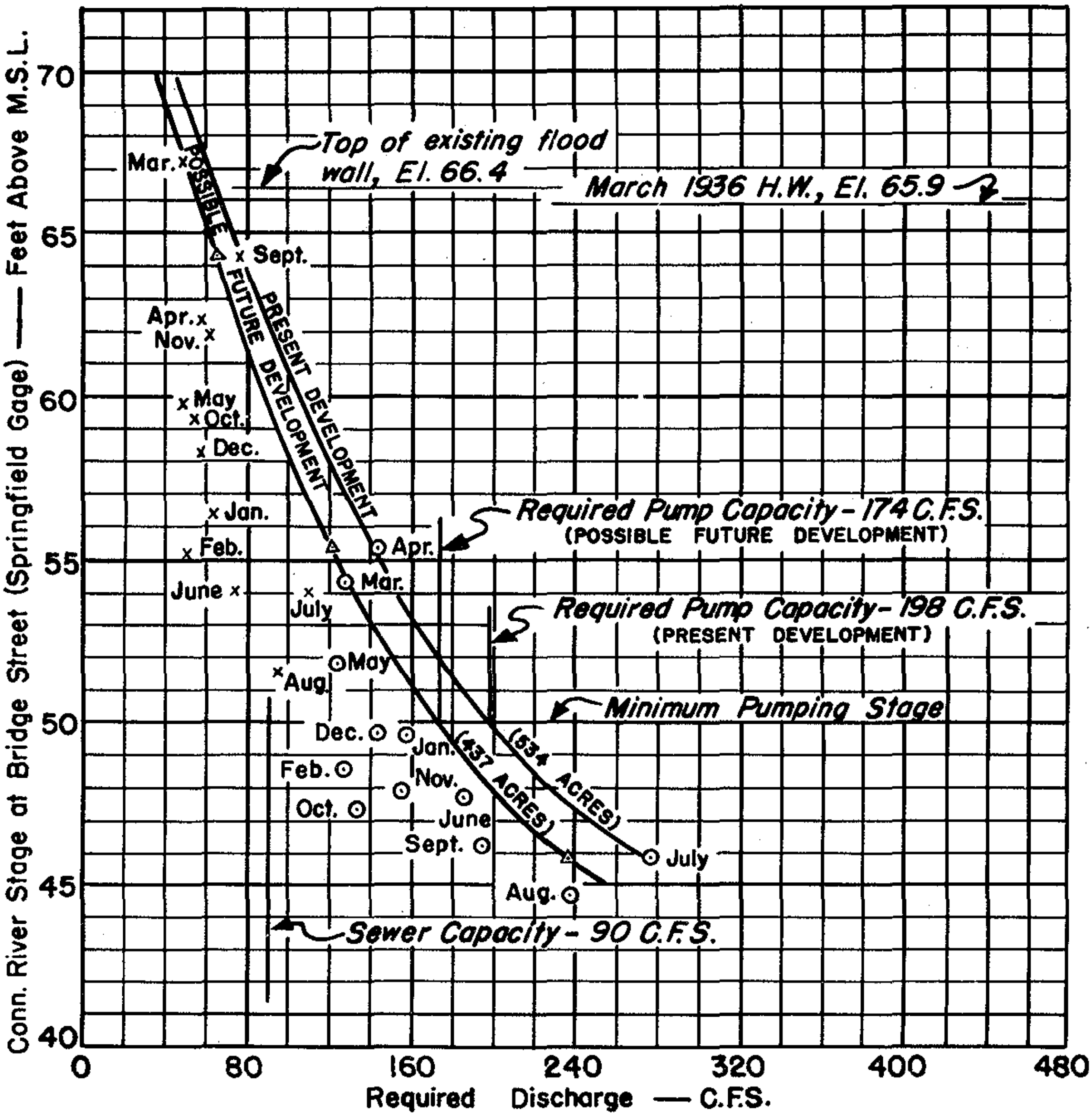
CONNECTICUT RIVER FLOOD CONTROL

BRIDGE STREET PUMPING STATION

STAGE-DURATION CURVE

CONNECTICUT RIVER, SPRINGFIELD, MASS.

PLATE NO. 9



LEGEND

× *1000 Yr. Stage vs 40% of Storm Run-off*

⊙ *10 Yr. Stage vs Full Storm Run-off*

△ *Controlling Points for Possible Future Development*

CONNECTICUT RIVER FLOOD CONTROL

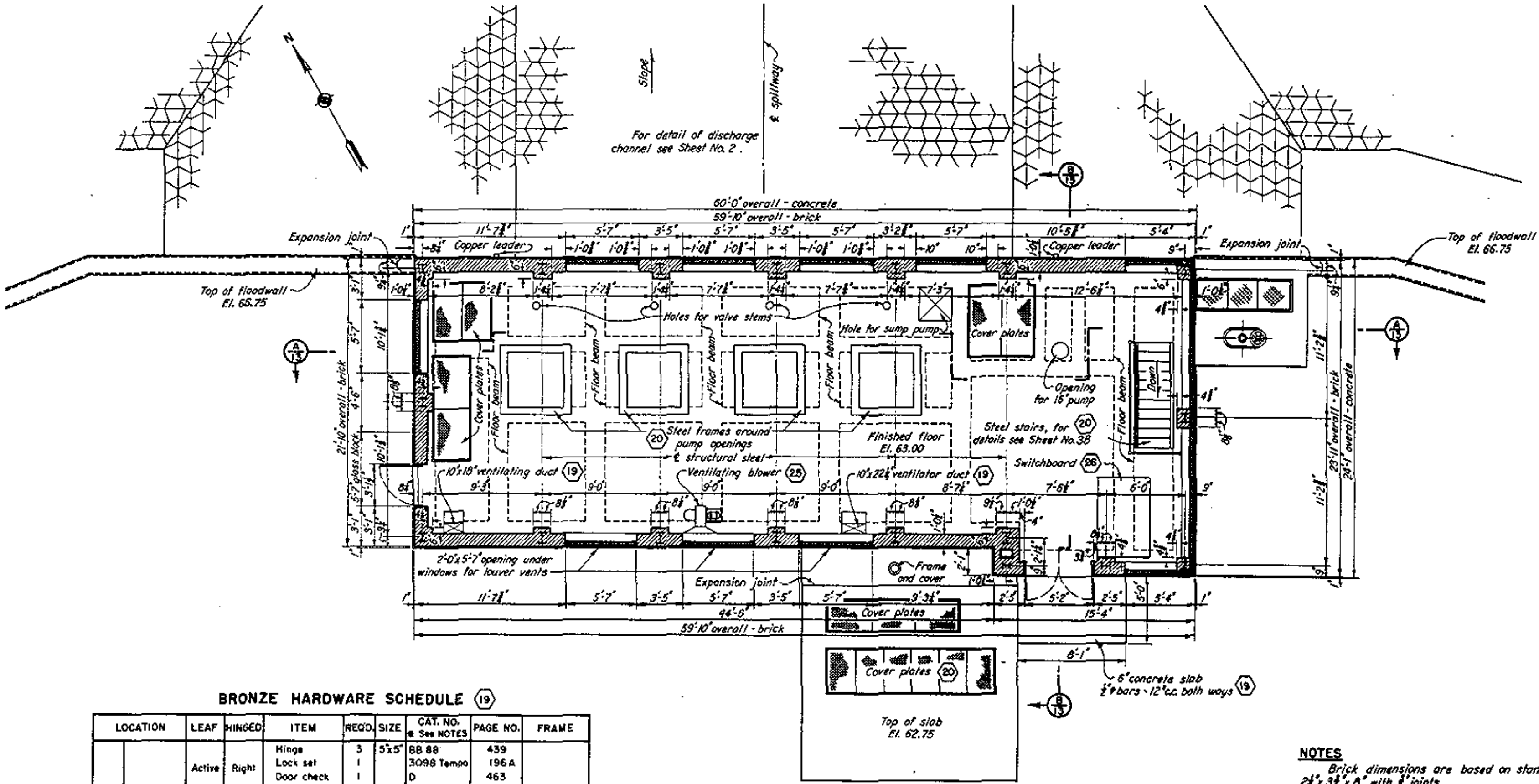
BRIDGE STREET PUMPING STATION

WEST SPRINGFIELD, MASS.

REQUIRED PUMPING CAPACITY

U.S. ENGINEER OFFICE PROVIDENCE, R.I.

PLATE No.10



ENGINE ROOM FLOOR

BRONZE HARDWARE SCHEDULE (19)

LOCATION		LEAF	HINGED	ITEM	REQ'D.	SIZE	CAT. NO. * See NOTES	PAGE NO.	FRAME
DOORS AS SPECIFIED Open out - Viewed from outside	ENTRANCE DOOR	Active	Right	Hinge	3	5"x5"	BB 88	439	As detailed
				Lock set	1		3098 Tempo	196 A	
				Door check	1		D	463	
				Bracket	1		128 D	472	
		Inactive	Left	Hinge	3	5"x5"	BB 88	439	
				Grips	2		Tempo	196 A	
				Chain bolt	1	8"	040	375	
				Foot bolt	1	8"	041	374	
				Door check	1		D	463	
				Bracket	1		128 D	472	
	SERVICE DOOR	Single	Left	Hinge	3	5"x5"	BB 88	439	
				Lock set	1		13013 Tempo	196 A	
				Door check	1		D	463	
				Bracket	1		128 D	472	
	RACK ROOM DOOR	Single	Right	Hinge	3	4"x4"	BB 88	439	Pressed steel frame as specified
				Latch set	1		029 LY 10	46	
				Door check	1		D	463	
	TOILET DOOR	Single	Right	Hinge	3	4"x4"	BB 88	439	Part of metal partition
				Bath door set	1		233 LY 1	46	
Located on partition wall				Coat & hat hook	1		054	503	

NOTES

Brick dimensions are based on standard brick 2¼"x 3¾"x 8" with ⅜" joints.

For electric circuits and fixtures see Sheet No. 51.

* *Catalogue numbers in Bronze Hardware Schedule are those of Russell & Erwin Mfg. Co. - Volume No. 16. Hardware to be similar and equal.*

KEY	DATE	REVISION (Indicated by △)	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL
BRIDGE STREET PUMPING STATION
WEST SPRINGFIELD, MASS.
ENGINE ROOM FLOOR PLAN
ARCHITECTURAL

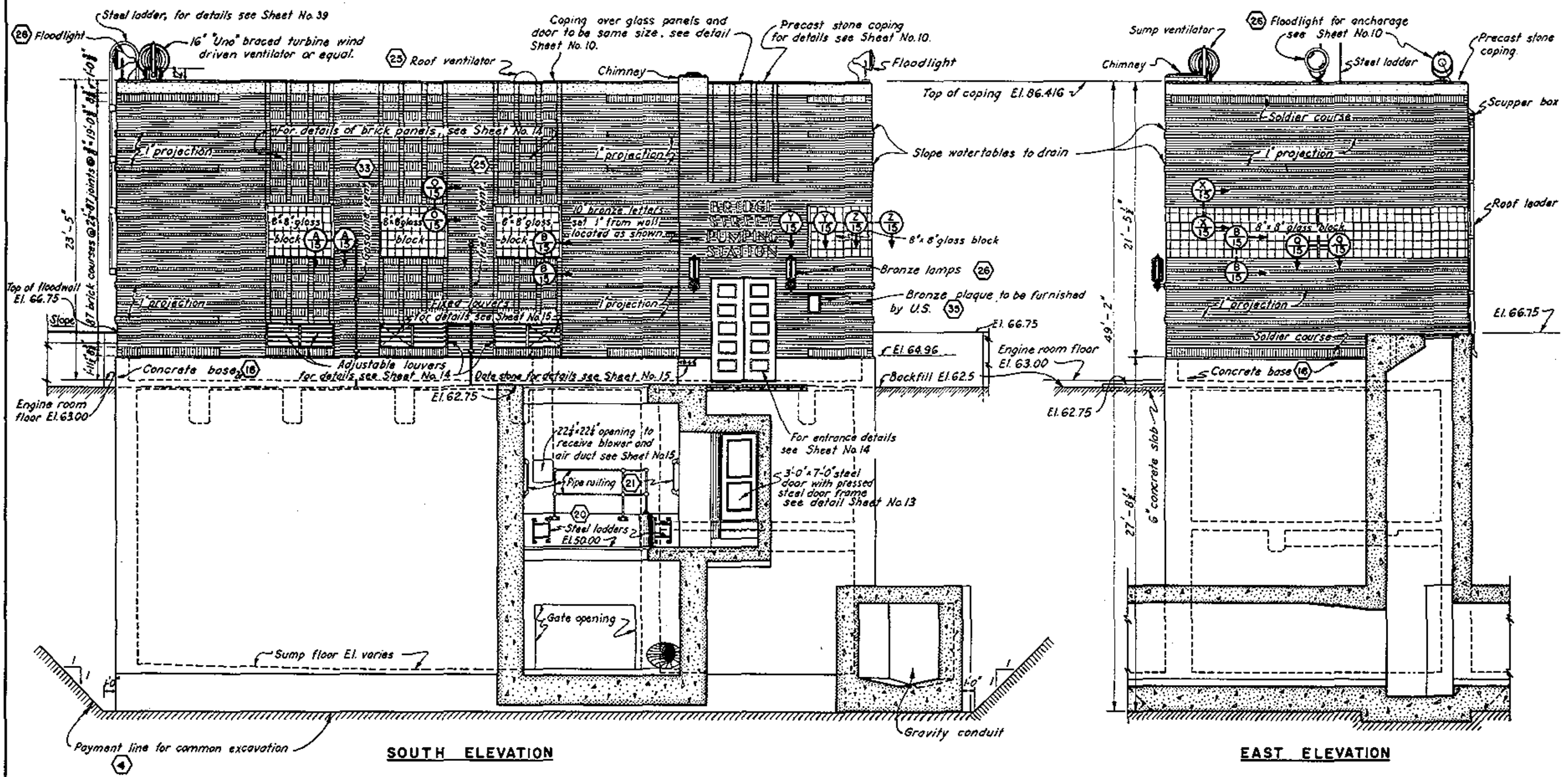
CONNECTICUT RIVER MASSACHUSETTS
IN 53 SHEETS SCALE 1/4 IN. = 1 FT. SHEET NO. 9
U.S. ENGINEER OFFICE, PROVIDENCE, R.I. JAN. 1941
SUBMITTED: SENIOR ENGINEER, HEAD, DESIGN SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, ENGINEERING DIV. — APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER
DESIGNED: E. M. ... ASSOC. ENGINEER — DRAWN: A.T. TRACED: L.F.G. CHECKED
FISCAL YEAR 1941
FILE NO. CT-4-2722

WS. 7b

PLATE NO. 11

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



SOUTH ELEVATION

EAST ELEVATION

NOTES

All items above top of concrete curb will be paid for under Item No. 19 except as noted by numbers in hexagons.

All vertical brick dimensions are from bottom of brick joint to bottom of brick joint. Unless otherwise noted.

Brick dimensions are based on standard brick $2\frac{1}{4}" \times 3\frac{3}{4}" \times 8"$ with $\frac{3}{8}"$ joints.

For electric circuits and fixtures see Sheets No. 51, 52 and 53.

KEY	DATE	REVISION (Indicated by Δ)	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL
BRIDGE STREET PUMPING STATION
WEST SPRINGFIELD, MASS.
ELEVATIONS NO. 1
ARCHITECTURAL

CONNECTICUT RIVER — MASSACHUSETTS
IN 53 SHEETS — SCALE 1/4 IN. = 1 FT. — SHEET NO. 11

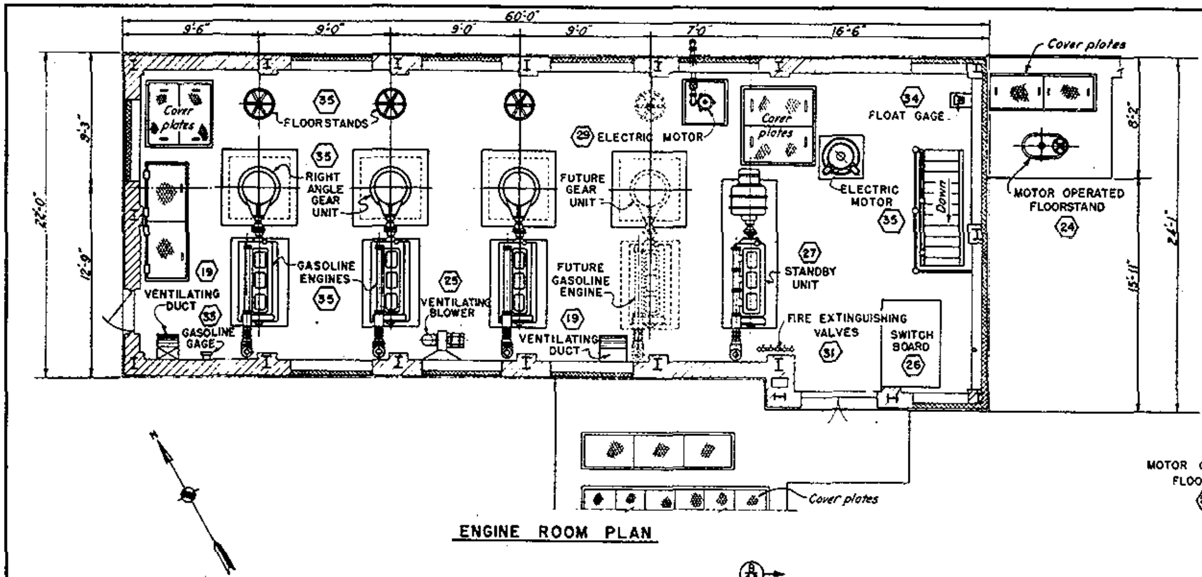
U. S. ENGINEER OFFICE, PROVIDENCE, R.I., JAN. 1941

SUBMITTED: SENIOR ENGINEER, HEAD, DESIGN SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, ENGINEERING DIV. — APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

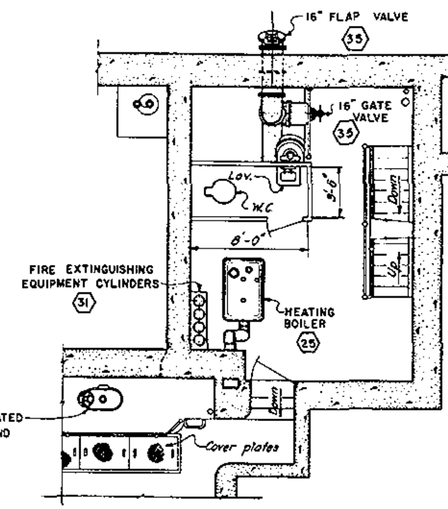
DESIGNED: — DRAWN: J.S. D B.G. — TRACED: C.W.A. — CHECKED:
FISCAL YEAR 1941
FILE NO. CT-4-2724

PLATE NO. 12

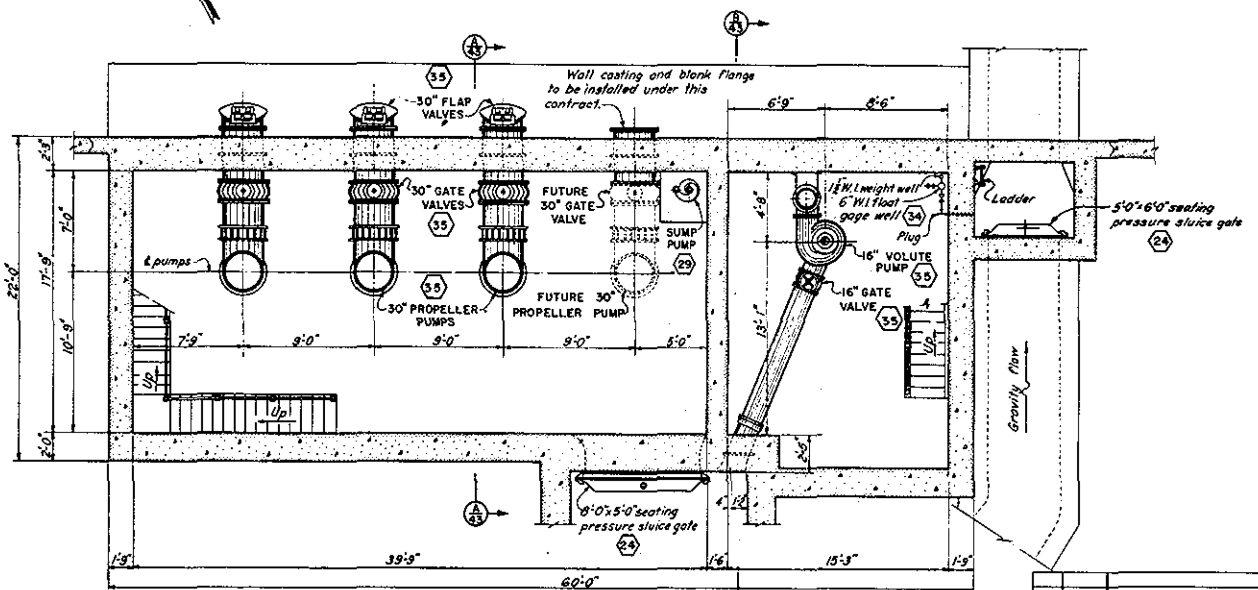
WS. 7b



ENGINE ROOM PLAN



BOILER ROOM PLAN



PUMP ROOM PLAN

NOTES

The gasoline engines, exhaust piping, silencers, couplings, gear units, 30" propeller pumps, 16" volute pump and motor, gate and flap valves, wall castings, blank flange and intake and discharge piping will be furnished by the Government.

KEY	DATE	REVISION (Indicated by Δ)	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL

BRIDGE STREET PUMPING STATION

WEST SPRINGFIELD, MASS.

GENERAL ARRANGEMENT OF EQUIPMENT NO. 1

CONNECTICUT RIVER — MASSACHUSETTS

IN 53 SHEETS — SCALE: 1/4 IN. = 1 FT. — SHEET NO. 42

U. S. ENGINEER OFFICE, PROVIDENCE, R.I., JAN. 1941

SUBMITTED: — APPROVAL RECOMMENDED: — APPROVED:

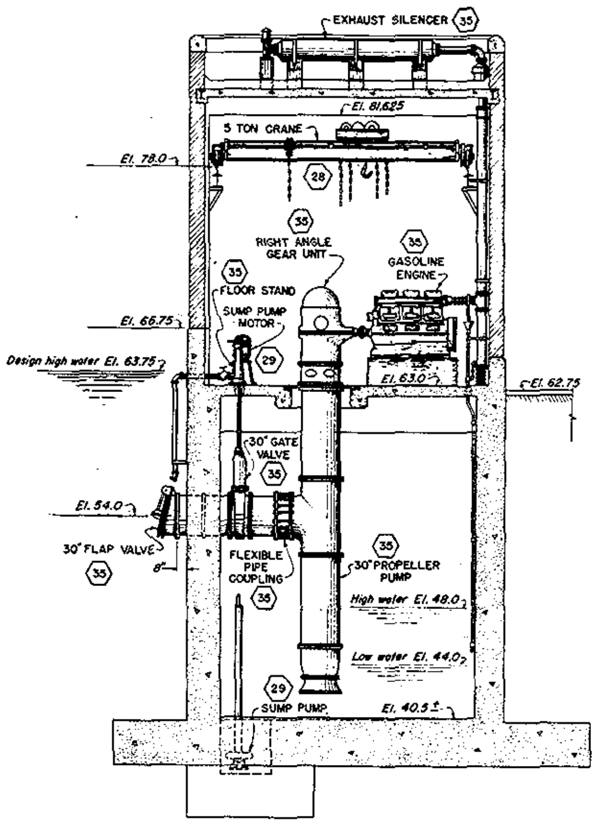
DESIGNED: — DRAWN: — TRACED: — CHECKED:

FISCAL YEAR 1941

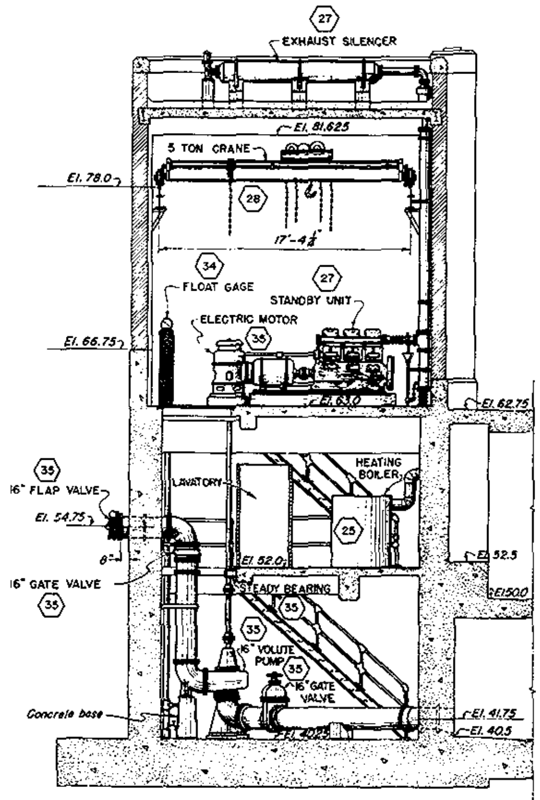
FILE NO. CT-4-2755

W.S. 7b

PLATE NO. 13



SECTION $\frac{A}{42}$



SECTION $\frac{B}{42}$

KEY	DATE	REVISION (Indicated by Δ)	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL

BRIDGE STREET PUMPING STATION

WEST SPRINGFIELD, MASS.

GENERAL ARRANGEMENT OF EQUIPMENT NO. 2

CONNECTICUT RIVER — MASSACHUSETTS

IN 53 SHEETS. SCALE 1/4 IN. = 1 FT. SHEET NO. 43

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., JAN. 1941

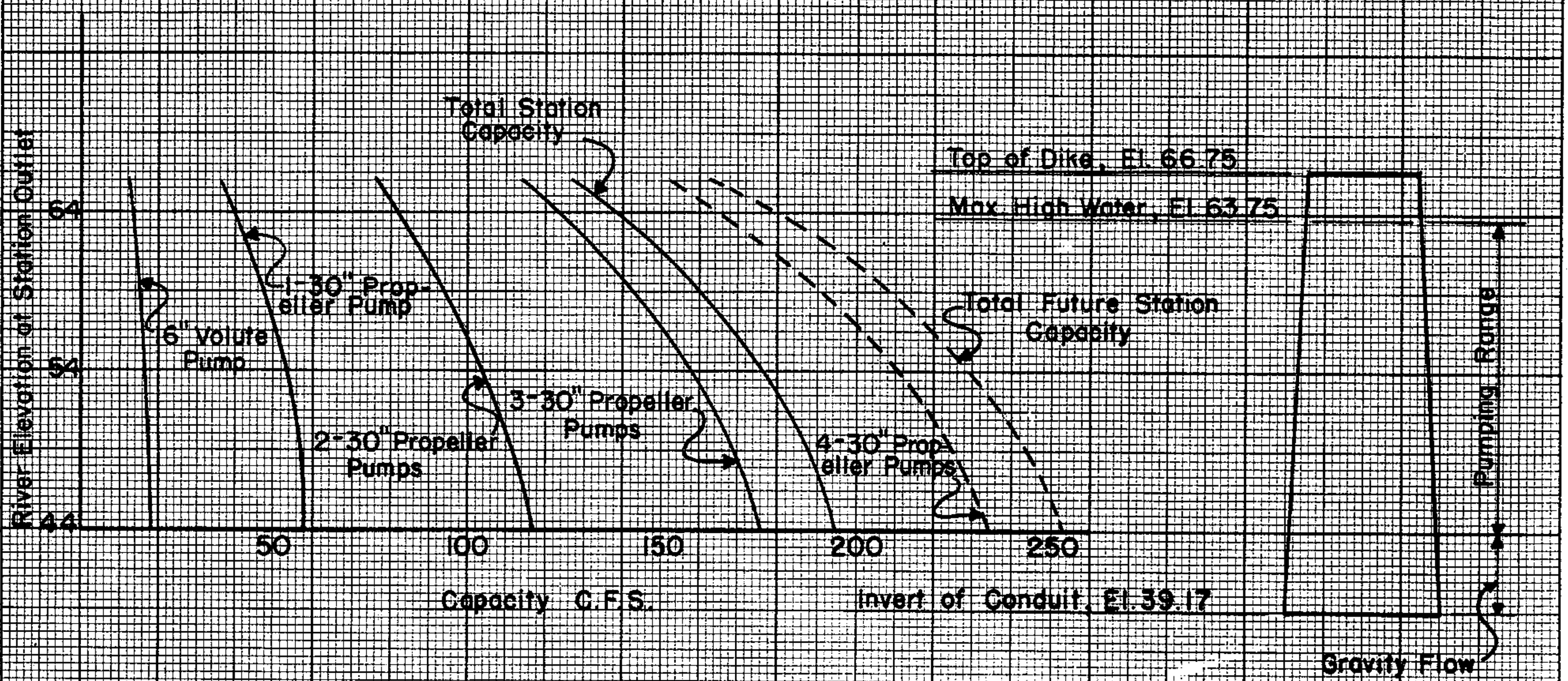
SUBMITTED: SENIOR ENGINEER, HEAD, DESIGN SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, ENGINEERING DIV. — APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

DESIGNED: — DRAWN: A.C. & B.J.F. TRACED: R.C.M. CHECKED: — FISCAL YEAR 1941

FILE NO. CT-4-2756

WS. 7b

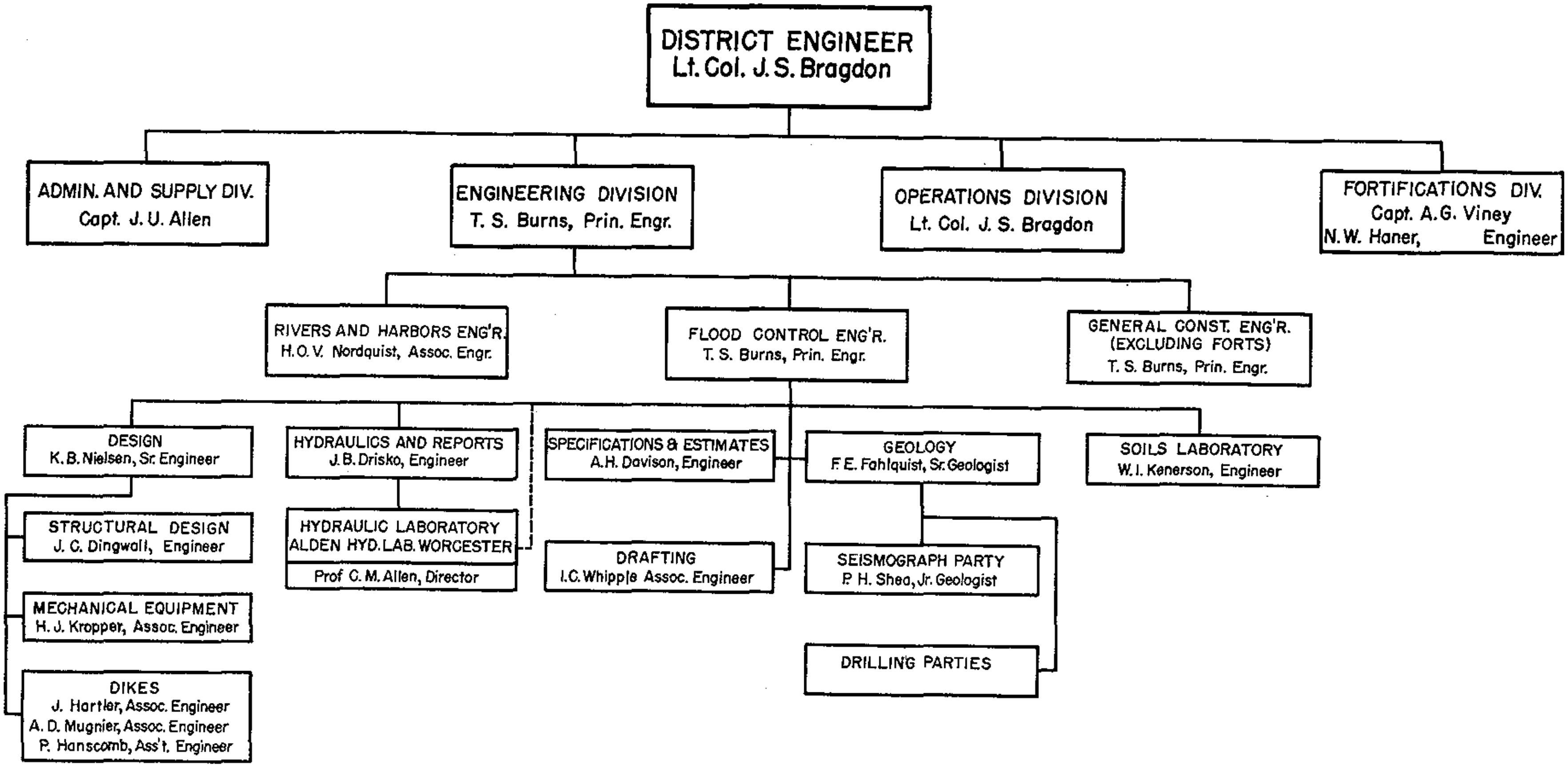
PLATE NO. 14



BRIDGE STREET PUMPING STATION
PUMPING CAPACITY

PLATE No. 15

PLATE NO. 16



ORGANIZATION CHART

ENGINEERING DIVISION

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

JANUARY, 1941